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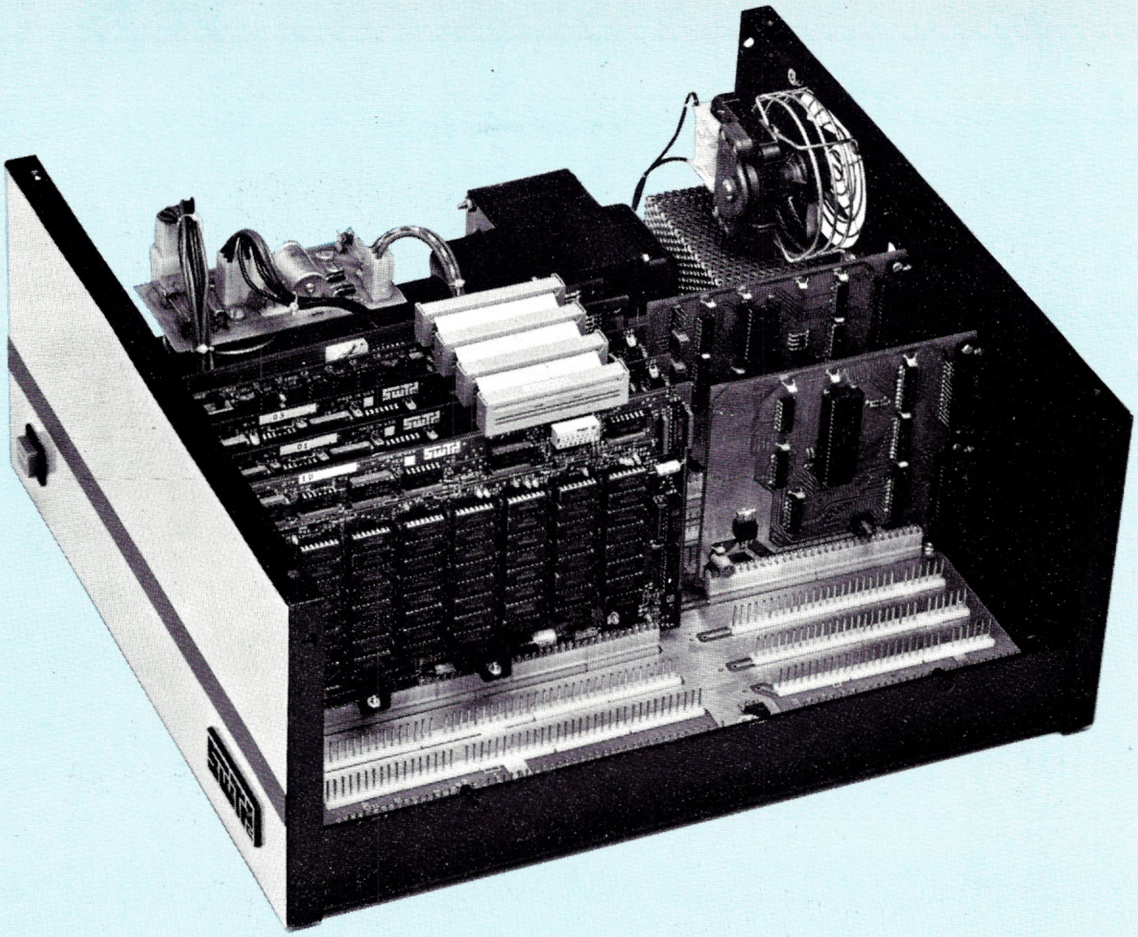

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Performance and capabilities never before possible are now available to you in the SWTPC S/09. Computer System.The S/09 uses the Motorola MC6809 processor, the most powerful 8-bit general purpose MPU available. It features more addressing modes than other 8-bit MPU's and an optimized consistent instruction set enhanced by powerful 16-bit instructions. This, plus 24 indexing submodes, promote the use of modern programming techniques like position independent code, re-entrancy and recursion.

The 20-bit address bus makes possible direct addressing of up to 768K of memory without any slow or clumsy processes such as bank switching. RAM memory is designed with independent control and array cards for economical expansion of memory. The DMA and the processor boards can access memory independently for different tasks.

Multiuser capability is "built-in". No additional hardware is required to operate additional terminals. A dynamic memory management system can allocate available RAM in as small as 4K blocks to the various users or tasks.

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Both multiuser and multitasking/multiuser operating systems are available for the S/09. BASIC, PASCAL and an Assembler are immediately available. Editor and Debug programs are also available for use in system development.

S/09 complete as shown with 128K bytes of RAM memory, one parallel and two serial I/O ports. . .$2,995.00

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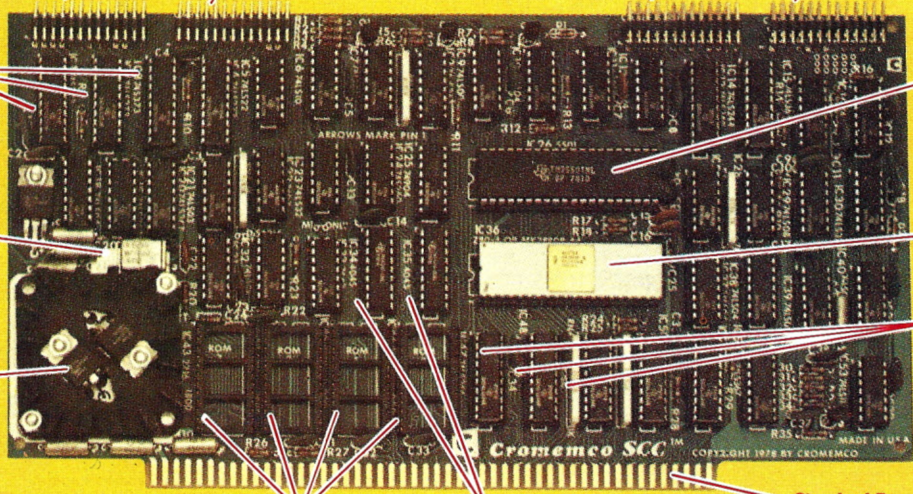

The single card computer with the features that help you in real life

COMPLETE COMPUTER

In this advanced card you get a professional quality computer that meets today's engineering needs. And it's one that's complete. It lets you be up and running fast. All you need is a power supply and your ROM software.

The computer itself is super. Fast 4 MHz operation. Capacity for 8K bytes of ROM (uses 2716 PROMs which **can be programmed by our new 32K** BYTESAVER® PROM card). There's also 1K of on-board static RAM. Further, you get straightforward interfacing through an RS-232 serial interface with ultra-fast speed of up to 76,800 baud — software programmable.

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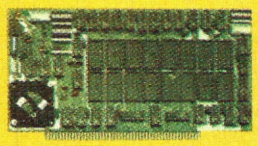
ENORMOUS EXPANDABILITY

Besides all these features the Cromemco single card computer gives you enormous expandability if you ever need it. And it's easy to expand. First, you can expand with the new Cromemco 32K BYTESAVER PROM card mentioned above. Then there's Cromemco's broad line of S100-bus-compatible memory and I/O interface cards. Cards with features such as relay interface, analog interface, graphics interface, opto-isolator input, and A/D and D/A conversion. RAM and ROM cards, too.

Card Cage



32K BYTESAVER PROM card

EASY TO USE

Another convenience that makes the Model SCC computer easy to use is our Z-80 monitor and 3K Control BASIC (in two ROMs). With this optional software you're ready to go. The monitor gives you 12 commands. The BASIC, with 36 commands/functions, will directly access I/O ports and memory locations — and call machine language subroutines.

Finally, to simplify things to the ultimate, we even have convenient card cages. Rugged card cages. They hold cards firmly. No jiggling out of sockets.

AVAILABLE NOW/LOW PRICE

The Model SCC is available now at a low price of only $450 burned-in and tested (32K BYTESAVER only $295).

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VOL. 4, ISSUE 12
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COMPUTING FOR HOME AND BUSINESS APPLICATIONS

THIS MONTH'S COVER
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INTERFACE AGE Magazine is catalogued in the Library of Congress, Classification No. QA75.5.155. ISSN Publication No. 0147-2992. Membership in Audit Bureau of Circulations applied for.
POSTMASTER: Please send change of address form 3579 and undelivered copies to **INTERFACE AGE** Magazine, 16704 Marquardt Ave., Cerritos, CA 90701. Second-class postage paid at Artesia, California 90701 and at additional mailing offices.

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CIRCLE INQUIRY NO. 8

HEATH PAYS A VISIT

Recently, I had the pleasure of meeting with some of the folks from Benton Harbor to discuss their new business systems line. Although I don't plan to do a story about the systems here, I thought you might enjoy seeing a picture of the innards of the WH89 Z-80 based small desktop system, Photo 1.

The WH89 represents only a small part of the new Heath line, but if that's all there was, it would be enough. The WH89 employs two Z-80s, one for the terminal and one for the computer. I could go on and on, but I don't want to spoil Tom Fox's upcoming review of it.

PHOTO 1 Heath WH89 Computer

Not only will we be reviewing the WH89, but also the new H11 system. Later, both the Heath systems will be part of a planned comparison story of the Radio Shack Model II, Vector Graphic MZ, Alpha Micro, Industrial Micro Systems, and a few more. This will be in the May business issue and will offer business buyers a helpful shopping list.

HANDY SOFTWARE AND CATALOGS

Just received the manuals for two exciting software packages from Disco-Tech. First, the Machine Language Utility Package. This is a package of routines designed for the experienced programmer to pull from while developing applications that require formatted input and scrolling. Also, tips on tape and disk care are covered in the 72-page manual.

The second program they sent me information about is Disc Drive Timer, which is an important program to assist the non-technical user by testing the disk drives for proper operation. The software displays what it's doing on the screen and tells you when a speed problem exists. The manual covers the steps to correctly adjust the drives for proper speed.

If these two programs sound like something you need, as a TRS-80 owner, contact Disco-Tech, a division of Morton Technologies, Inc., 1150 Coddlingtown Center, P.O. Box 11129, Santa Rosa, CA 95406, phone (707) 527-8500.

Those of you looking for books or just collecting catalogs will want to contact Telecom Library Inc., 205 W. 19 St., New York, NY 10011. The Telecom Library sells books and carries a very complete line of data processing books for the professional and not so professional. This appears to be a good source.

THE FCC DECISION

The biggest news of the year came out of Washington, D.C. this past September with a great deal of indecisiveness on the parts of both the FCC and many manufacturers.

The Federal Communications Commission announced on September 18 the new rules that will affect the burgeoning home/business computer market. Basically what the commission said was that it would allow the use of home computers with RF demodulators in conjunction with home television sets, within given guidelines.

The rules or guidelines set up two distinct categories: The first, Class A, is for industrial computers, which are used in high electrical noise areas. Computers used in this classification are allowed a maximum RF emission of 300 microvolts at 3 meters.

The Class B category, for mass market or home computers, allows a maximum of 100 microvolts at 3 meters. Television games, however, are only allowed a maximum radiation of 5 microvolts at 3 meters.

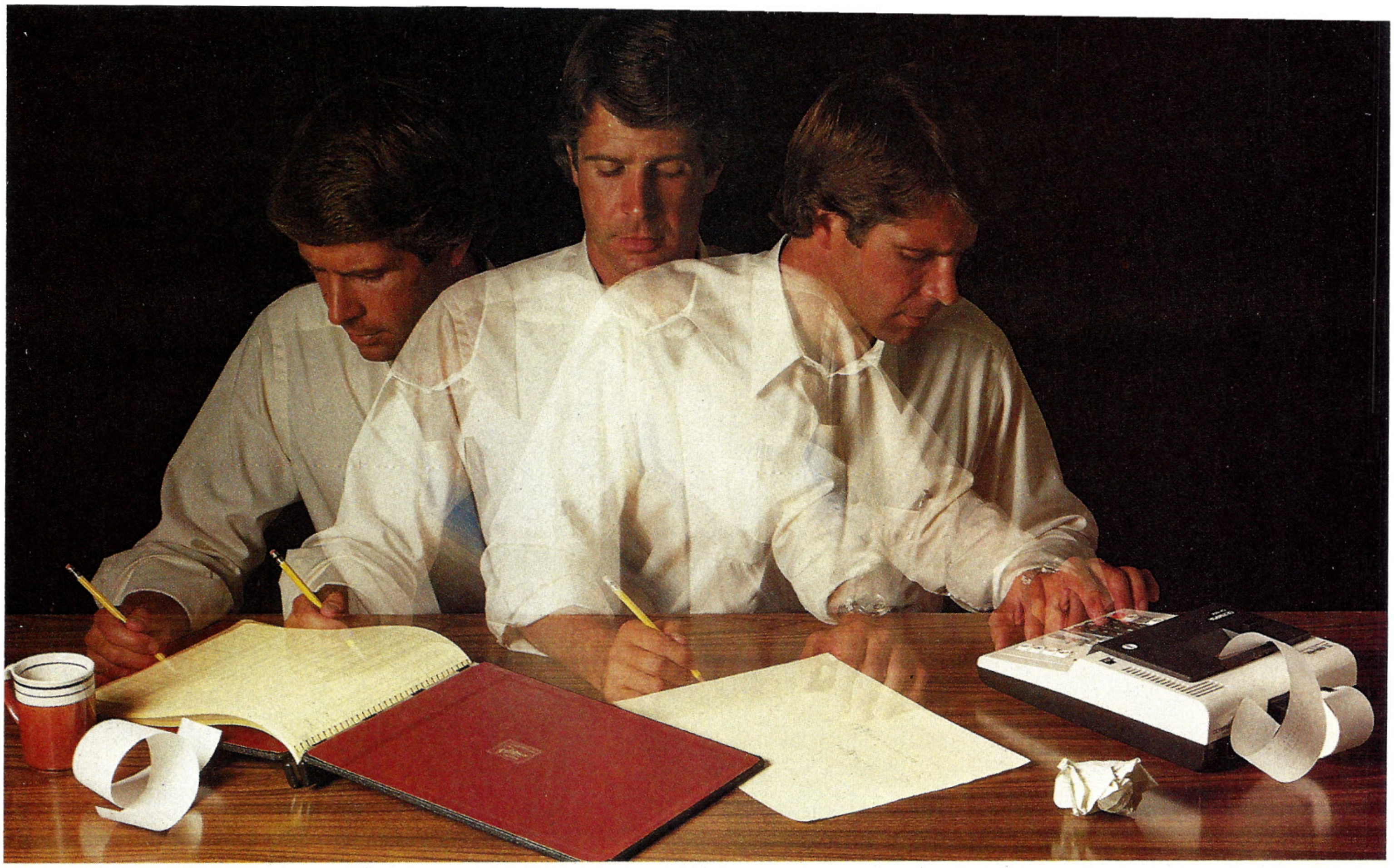
According to an FCC spokesman, the project on determining the maximum radiation started in May, 1979, when companies were asked to send a system for measurement. The measurements were made by placing a dipole antenna three meters away from the case and raising and lowering the antenna until a maximum level was measured. Then the computer was turned to find the maximum radiation point.

From the initial report, the Texas Instruments 99/4 and the Commodore PET had the least level of interference, while the Apple and Radio Shack machines produced the most.

The response to the FCC announcement was met with varying reactions among the companies directly affected by the rule changes.

A Radio Shack spokesman said that they felt the FCC announcement represented a precipitous action with the rules being made without a rule-making procedure. However, they did feel that the July, 1980, compliance date did give the industry time to meet the new rules, especially since they would not be required to completely retool or redesign existing systems. Radio Shack felt that before they could comment further on the effect of the new rules it would be necessary to fully analyze and review the report.

Texas Instruments, however, was more than pleased with the FCC ruling since they had petitioned for a waiver of the rules for release of their low end systems. In light of the announcement, TI released the follow-



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VisiCalc is a new breed of problem-solving software. Unlike prepackaged software that forces you into a computerized straight jacket, VisiCalc adapts itself to any numerical problem you have. You enter numbers, alphabetic titles and formulas on your keyboard. VisiCalc organizes and displays this information on the screen. You don't have to spend your time programming.

Your energy is better spent using the results than getting them.

Say you're a business manager and want to project your annual sales. Using the calculator, pencil and paper method, you'd lay out 12 months across a sheet and fill in lines and columns of figures on products, outlets, salespeople, etc. You'd calculate by hand the subtotals and summary figures. Then you'd start revising, erasing and recalculating. With VisiCalc, you simply fill in the same figures on an electronic "sheet of paper" and let the computer do the work.

Once your first projection is complete, you're ready to use VisiCalc's unique, powerful recalculation feature. It lets you ask "What if?", examining new options and planning for contingencies. "What if" sales drop 20 percent in March? Just type in the sales figure. VisiCalc instantly updates all other figures affected by March sales.

Or say you're an engineer working on a design problem and are wondering "What if that oscillation were damped by another 10 percent?" Or you're working on your family's expenses and wonder "What will happen to our entertainment budget if the heating bill goes up 15 percent this winter?" VisiCalc responds instantly to show you all the consequences of any change.

Once you see VisiCalc in action, you'll think of many more uses for its power. Ask your dealer for a demonstration and discover how VisiCalc can help you in your professional work and personal life.

You might find that VisiCalc alone is reason enough to own a personal computer.

VisiCalc is available now for Apple II computers, with versions for other personal computers coming soon. The Apple II version costs just $99.50 and requires a 32k disk system.

For the name and address of your nearest VisiCalc dealer, call (408) 745-7841 or write to Personal Software, Inc., Dept. I, 592 Weddell Dr., Sunnyvale, CA 94086. If your favorite dealer doesn't already carry Personal Software products, ask him to give us a call.

PERSONAL SOFTWARE

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New 1.2 megabyte quad-density disk. $1545.
Now you can afford to put a million bytes of memory in your S-100 system.
Introducing DISCUS 2+2™ full-size quad-density floppy disk system by Morrow. DISCUS 2+2™ gives you 1.2 megabytes per diskette (600K bytes of double-density data per side). And it's all addressable as easily as main memory with the system's exclusive BASIC-V™ virtual disk BASIC software.
Best of all, DISCUS 2+2™ comes complete, assembled, and ready to run for just $1545. Included in the system price are an S-100 controller, factory-mounted full-size disk drive, a complete library of pre-interfaced software, even cables and connectors.
But you don't have to get your first million in one big megabyte. Morrow's DISCUS/2D™ single-side double-density floppy disk system gives you 600K per full-size diskette for just $1149, complete and assembled. And when you want to expand to a full megabyte, just plug in a second drive... both the hardware and software are expandable.
And if economy is a real concern, you can still get started on your million with Morrow's DISCUS I™ 250K single-density disc system. It's delivered complete and assembled for just $995...and will accept up to 3 more drives.
All three Morrow disk systems meet the Proposed IEEE S-100 standard and are compatible with 2MHz, 4 MHz and 5 MHz S-100 systems. A dual-drive cabinet is available as an option with any density you choose.
Why set your goals low and slow with a mini-floppy system? Get started on your first million with a DISCUS™ full-size system by Morrow. See your local computer shop. Or write Thinker Toys,™ 5221 Central, Richmond, California 94804. Or call (415) 524-2101, weekdays 10-5 (Pacific Time).
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ing statement:

"We are pleased with the decision reached by the FCC at its September 18th meeting concerning the petition for rule change and our request for a waiver to market a home computer using a modulator which complies with the proposed rules.

"The final text of the Commission report and order has not been released. We believe the ruling will permit Texas Instruments and other manufacturers to market lower cost computers which use the home television, which will benefit the consumer and aid in the development of the home computer market.

"We are continuing our program with the 99/4 home computer with its monitor. Before we can comment further concerning the commission action, we will need to review its report and order."

In general, the industry was pleased with the rule change proposed by the FCC. Most of the companies that I talked to at the WESCON show in San Francisco felt that the home computer industry would now be able to grow at a level even greater than imagined.

My feelings are that even though the consumer computer has not come of age and has a long way to go, this recent ruling has advanced the industry by five years.

WHILE UP NORTH

While at the WESCON show I had the chance to visit Bill Godbout again and George Morrow at Thinker Toys. George had a previous meeting set up with Tim Paterson from Seattle Computer Products on the new S-100 bus standard, so I didn't get to spend too much time with him, but will be taking you through Thinker Toys in next month's Notebook.

While Tim was there he did show me a couple of new boards that are available from his company. The first is a 16-bit dynamic memory using 4044s and meets the new S-100 standard. The board sells for $595 assembled, tested and burned in. The other offering is an 8086 CPU board for less than $900. By the time you read this, it will be on the market.

Those of you who might be interested in Tim's new products might drop a note or give them a call at: Seattle Computer Products, Inc., Koll Business Center, 1114 Industry Drive, Seattle, WA 98188, (206) 575-1830, Attn: Tim Paterson, 8086 Project Engineer. Both Bill and George say these folks do good work, and that's good enough for me.

Even though my primary objective in visiting Godbout this trip was to say Hi and have a bite of lunch, I thought I better see what he had been up to. As luck had it, he had been up until 4 a.m. the night before, finishing up a contract for the distribution rights for Pascal from Digital Marketing.

This particular version of Pascal is CP/M compatible and allows the use of any data

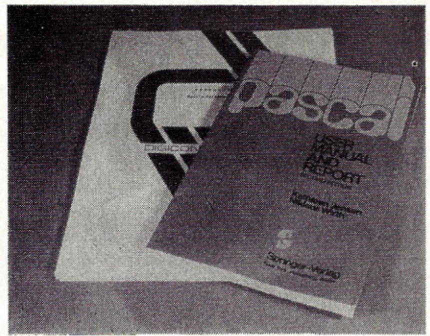


PHOTO 2

files you may be using in your system. It is a completely developed Pascal compiler and comes with a Pascal User's Manual and Report by Jenson and Wirth, and a Pascal/M User's Reference Manual, Photo 2. Both books are the easiest to read and understand that I have seen so far.

The price of the Pascal and manual is $350 with the manual available for $35.

Because the software requires 65K and one floppy, Godbout is offering a package deal of a 32K EconoRAM board and Pascal, both with complete documentation, for $799, a $200 saving. Bill's only offering this for the first 200 units, so you better get in touch with any Godbout distributor or call Godbout Electronics, Bldg. 275, Oakland Airport, CA 94614, (415) 562-0636.

A QUICK LOOK AROUND

Should you be thinking of a single board computer (SBC) to get started with or for development work, you should seriously consider the Rockwell AIM (Advanced Interactive Microcomputer). This is the only SBC to offer an onboard computer and can be used in education or as a smart terminal.

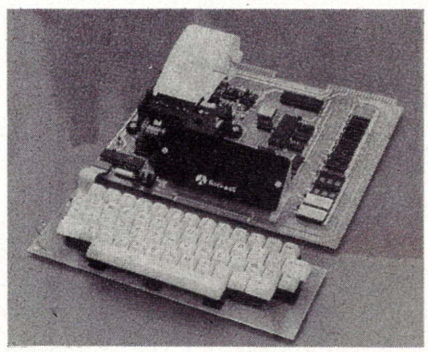
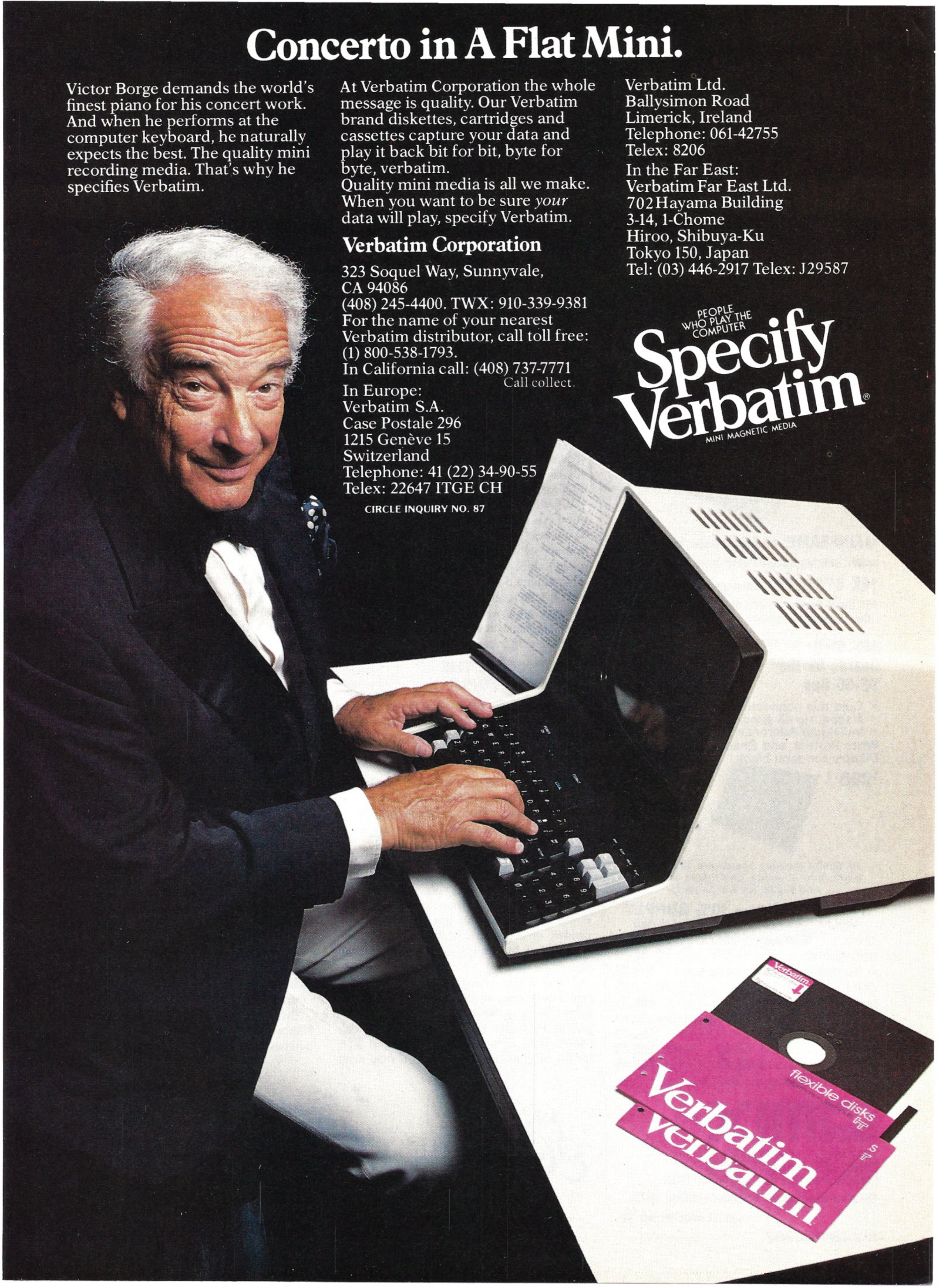


PHOTO 3 Rockwell AIM 65

The AIM, Photo 3, is built around the R6502 CPU which is the same brain found in Apple, Kim and PET systems. The system is fully expandable and offers a great deal. To find out more about this little computer write to: Rockwell International Electronic Devices Div., 3310 Miraloma Ave., Anaheim, CA 92803.

ABOUT PASCAL

Our Pascal Notebook, by Henry Davis, has really been receiving a great deal of comment, most of it extremely favorable. However, many readers have said that it is so comprehensive that it requires several readings to fully understand. This we realize.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Our goal with the series was and is to provide a complete indepth approach to the subject of Pascal so that we can build upon what Henry has presented.

And build we plan to do in 1980. We have a number of very exciting Pascal articles coming, with more Pascal tutorials that offer real programs and many many examples. Those of you who are true aficionados of Pascal will be glad to know that Henry's Pascal Notebook is presently being made into a three-volume series which will be available from dilithium Press sometime in the first quarter of 1980.

WHAT HAPPENED TO THE FLOPPY ROM™?

During the past year I have been asked whether or not we plan to continue the Floppy ROM. My answer has been yes. But as I have said many times before, the Floppy ROM needed a little help on the engineering side to make it even more useful.

We have worked out a method which allows us to perform greater data compaction on the record and at the same time strip it off for use on virtually any machine.

What this means is that we will be able to bring you Floppy ROMs with complete databases, total systems software and a number of other things that we just aren't ready to talk about.

Sometime during the next few months, we will be talking about the new Floppy ROM concept, along with providing INTERFACE AGE readers with an understanding of fiber optics in data transmission.

DRAGONS ARE THE CRAZIEST PEOPLE

Those of you who have been reading microcomputer magazines and books for the past several years probably know what a dragon is. Those of you who don't may want to learn.

A dragon is a strange beastie that thinks in the future, loves children, computers and life, in that order, and comes primarily in the form of Bob Albrecht and a wild magazine called *Recreational Computing.*

This magazine is not new in concept or contents, only in name. Originally known as *People's Computers, RC* is the one magazine on the market today that touts computer literacy and fun. *RC* is an outgrowth of Albrecht's philosophy on computers and life in general. He feels both should be fun.

Those of you who get into the games and real down-to-earth fun of computing can subscribe by writing to *Recreational Computing,* P.O. Box E, 1263 El Camino Real, Menlo Park, CA 94025 and sending $14 for a one year subscription. You may want to write to dragonland just to find out about Computerland, U.S.A., or to share a fun experience with the rest of the dragons.

IN CASE YOU HADN'T NOTICED

I am personally excited about this December issue for several reasons. One, we are starting Al Baker's Game Corner for game enthusiasts. Two, it marks the end of my second year as the editor of the magazine. Three, because we have the chance to provide you with the best possible editorial for another 12 months; not only a new year, but a whole new decade.

The propsect of starting a new decade engaged in an exciting high-technology area that must be talked and written about is almost better than Christmas every day. With all this excitement, what can you look for?

Some of the new things you will see are the use of more 16-bit machines, much better software, and the introduction of a new high level language that will make everything else look passe.

Probably the most exciting thing that you will see in the early 80's will be the use of microprocessor control in just about every aspect of daily life. Yes, it is in use now, but a number of companies have some items on the boards that will save businesses and households time, money, and most importantly, energy.

Flat screen display will be introduced in both television and terminal use in the first few months of 1981, with the first announcements being made at the 1980 NCC by a very large component manufacturer in Texas.

Advancements in technology that will be introduced in the next three years will make Orwell's 1984 seem commonplace in comparison. Future shock, 1984, or whatever you want to call it, is not around the corner. It is already here.

WHAT WE PLAN TO DO

This coming year, INTERFACE AGE will be bringing you even more than we did in '79. Three major tutorials, more business software and helpful hints, more Albrecht, more education and more suprises.

One of the surprises we have in store for you is the construction of a complete system based around the new Motorola 6809. We even will provide you with the software from BASIC to PILOT. This series begins with the February issue.

Our April Robotics issue will introduce you to a new character on the INTERFACE AGE staff that you will be able to build yourself.

But until then, Merry Christmas and a Happy New year from all the editors, authors, and folks at INTERFACE AGE.

—carl

A CHALLENGE

Dear Editor:

This is to inform you and any interested programmers that I have a standing offer of $500 to the first programmer who can come up with a checkers program that can beat me in a 20-game match.

When you consider the fact that there are thousands of people in the world who can beat me at the game of checkers, this challenge does not appear so great. I really could not gain a rating as a strong amateur. But — there the offer is, and if anyone is interested, I will be eager to send a certified check to be held pending the outcome.

My offer entails only the following conditions:

1. The program must play 3-move restriction.
2. It must be capable of being played on my Apple II (with full memory capability plus firmware card and floppy).
3. It must play both the white and black side of each opening.
4. Win, lose, or draw, I must have a copy of the program that will play on my Apple II.

I admit that $500 is no financial grabber, but checker players are poor folks. But just to show you that I'm on your side, to anyone who writes I'll give the name of the world's greatest, who might help with the creation of the program.

Z.L. Langley, Sr.
3301 Shipwright St.
Portsmouth, VA 23703

Here's a man in need of a game and is willing to pay. Can anyone do it?

FIRST ANSWER TO "I THINK"

Dear Editor:

I believe the first mass application of the computer in the home will be as a replacement for the newspaper.

1. A radio station will transmit the newspaper in code. Headlines updated every half hour. The bridge game once per day. The stock market twice per day.

2. A receiver in the home will feed the "newspaper" to computer memory.

3. The user will at any time he so wishes sit down and push some buttons on a control box. The "newspaper" will appear on his TV screen. He will scan the headlines. Read in detail any articles he so wishes. Skip the others. If he needs a pair of pants he will scan the advertisements for a sale on trousers. He will read the paper just as he does an ordinary paper.

4. Advantages over conventional newspapers:

- Cheaper. No newspapers to print and deliver.
- News is at most a half hour old. Rather than at least 6 hours old.
- No littered living rooms. No newspapers to pick up and deliver to the trashman.
- Articles to be permanently stored can be stored on mag tape. No large storage space required.

George E. Row
Indianapolis, IN

MORE ON A FUNCTION APPROXIMATION PROGRAM

Dear Editor:

An article of mine, *A Special Function Approximation Method and Its Application* appeared in the October, 1978 INTERFACE AGE. There was a letter by Alan Miller concerning my ideas in the February, 1979, issue. It seems that my original article was not quite clear, because even for experts like Dr. Miller it caused certain problems.

I offer these answers to Dr. Miller:

1. The line 335 in some BASIC variations, where there are less than 8 digits of accuracy, is ineffective. One can help if instead of using the given 1.0000001, the expression $1 + 10^{-n+1}$ is used.

   For example, in case of only four accurate digits, the expected number is 1.001.

2. Checking the numerical example shown by Dr. Miller: 0,1;1,3;2,5 I find the following:

   After running lines 90-120 the following results are given:

   X/1/=0 X/2/=1 X/3/=2
   Y/1/=1 Y/2/=3 Y/3/=5

   after lines 146-151:

   X1=0 X2=2
   Y1=1 Y2=5

   after lines 152-155:

   X/1/=0.3 X/2/=0.6 X/3/=1
   Y/1/=0.2 Y/2/=0.6 Y/3/=1

   In the line 280 zero divide can occur only if

   U ÷ /PxP/ = 0

   which means either

   P = 0 or $P \times P < \varepsilon$

   where ε is the least positive number which the given BASIC takes as the number differing from zero. The first case would appear in the example if

   P = LOG/Y/3// = LOG/1/ = 0

The BASIC for these machines gives the following values for these two machine-dependent constants:

ε = 1E-99
Max > 9E99

Running my program with the given values on an SWTP 8K BASIC 2.0 achieved the following results:

N=3 A=-0.2111128905 B=1.25265179
S = 9.07377E-04
F = SIN / / G = SIN / /

It seems the program does not give the expected

$$y = 1 + 2 \times X$$

result. The reason for this is that the program stops at the first "good" approximation and this criteria is based on real experimental data. Modifying line 141, one can select the S1 value given there. Due to the limited accuracy of the calculation, its minimum is

2E — //N — 2/ ÷ 2/

where N is the number of significant digits of the given BASIC version.

COMING NEXT MONTH

Microprocessor chips are being manufactured by the thousands, so it could only be expected that some of them are starting to end up in unusual places. Although the bulk of the chips are being used in standard microcomputer systems, more and more are being used to control various devices.

In automobiles, the Intel 8084 is helping to improve air quality and gasoline mileage by monitoring the emissions and tuning the carburetor to provide the best air-fuel mixture.

And in the home, chips are being used to control several appliances, from televisions to food processors to blenders. And it seems only logical that one of the commonplace inventions of the technological age, the microwave oven, is now being managed by a microprocessor. We'll be looking into these new ovens, and some of the other computerized home appliances.

Another specialized control function of the micro is helping the handicapped who have lost the ability to speak. With a handheld unit that features unlimited voice synthesis, a person can program either his own answer or a preprogrammed set of common phrases. By using this powerful machine, one cerebral palsy victim has become a lay minister.

Along with this examination of some interesting and unusual applications of micros, we'll have our usual supply of articles on more standard microcomputer applications. You'll find software for a simple mailing label program, along with a program for database management on the Apple.

And with the New Year comes the newest of the INTERFACE AGE tutorials, Using and Building a Micro-Based System. David Marca's articles will explain some of the theory and pitfalls to avoid for those just beginning to computerize, and offer several tips for learning to program in FORTRAN.

These features, along with our ever-popular monthly columns and several reviews of software and hardware and the usual surprises, make the January of INTERFACE AGE a must for anyone interested in computers.

In my machine N = 10, so S1 = 2E — 4. Running the program again achieved the following results:

N=3 A=-0.199999933 B=1.19999987
S = 1.5275253E-04
F = / / G = / /

Here the equation resulted by an absolute approximation is the following:

$$Y = -0.2 + 1.2 \times X$$

This value again is different from the expected. The reason for this is that the program is giving an equation on a function which is fitting transformed data. From this transformation you can get the original equation with the following inverse transformations:

XO/I/ = XN/I/ x /X2 — X1 + 1/ — 1 + X1
XO/I/ = YN/I/ x /Y2 — Y1 + 1/ — 1 + Y1

where O-original, N-new.

I should like to mention that both the original article and Dr. Miller's letter contained certain program errors. The correction to those are the following:

1. The PRINT statement in the program has to be changed as follows (see Dr. Miller's suggestions)
   0041 PRINT" A,B — CONSTANTS"
2. Lines 161-165:
   0161 C1 = 0
   0162 C2 = 0
   0163 C3 = 0
   0164 C4 = 0
   0165 C5 = 0
3. Line 380 should look as follows:
   IF M <100 THEN 160

In closing, I hope that with these additions and modifications my methods and program can be used by everyone.

Dr. Endre Simonyi
Budapest, Hungary

ONE MORE HAPPY CUSTOMER

Dear Editor:

Readers may be interested in my recent good experience as a customer of one of your new advertisers, Radio Hut, of Garland, Texas.

I ordered a 64K SD Expandoram kit from them at their bargain price. I received the kit within a week or so, which is a very quick delivery. However, before I started to build it, I found out from other sources that the Expandoram unit is not designed to run at 4 MHz, which is the capability I needed.

So I telephoned Radio Hut about my problem. They were very courteous and helpful, but not good about returning phone calls. After I had evaluated some alternatives with them, they did not hesitate to oblige my request for return of the purchase price.

I have all of my money back now, and have been thinking over the transaction. It turns out that the entire fault was mine for ordering the wrong thing.

I think that is pretty good customer treatment. And because of it, I certainly would not hesitate to do business with them in the future.

Hugh B. Thompson
Santa Ana, CA

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We've researched the under-$1,000 80-column dot matrix printers currently available, and have made some key comparisons in the chart to the right. Check it out.

All the printers support the full 96-character ASCII set, print on pin feed non-thermal multi-copy paper, accept forms in various widths up to 9.5", and easily interface to all popular small computers.

If you want to print graphics or feed single sheets of paper through your printer, we can't help you. But if you want as much data buffer storage as you can get, a 9 x 7 dot matrix for better looking characters, a condensed character set that's great for printing multiple columns of numbers, a readily available low cost ribbon, and documentation that includes complete schematics and troubleshooting procedures, then we can help you a lot. And we can offer you something else that's new to the low-cost printer market. Our 30 day BUY BACK guarantee. If you buy a MICROTEK printer and are unhappy with it, for any reason, you can return it within 30 days for a full refund. It's that simple.

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9 x 7 Dot Matrix	**Yes**	Yes	No	No	No	No
Sustained thruput for full lines	**70 LPM**	84 LPM	21 LPM	63 LPM	42 LPM	60 LPM
Selectable condensed character set	**Yes**	No	No	No	Yes	Yes
Full function VFU	**Yes**	Yes	No	No	Yes	No
Built-in self test	**Yes**	No	No	No	Yes	No
Graphics option	**No**	No	No	No	Yes	No
Accepts single sheets of paper	**No**	No	Yes	No	No	Yes
Ribbon costs	**$2.00**	$3.00	$4.50	$4.00	$12.00	$9.95
Cost of 2k/4k buffer	**$42/$80**	$45/NA	NA/NA	NA/NA	$199* /NA	$50/NA
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* Memory buffer alone not available, includes graphics option

Comparison data from manufacturer's current (September '79) literature.

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NEW MEDICAL JOURNAL

Dear Editor:

I would very much appreciate your bringing the attention of your readers to the Medical Computer Journal. The Journal is a publication of the Doctors Computer Club.

In each issue there will be discussed one of the most common illnesses, a computer system, laboratory test interpretation, and ideas for office improvement through the use of the computer. The major thrust of the publication is to bring the computer and the private physician together, and assist them in using the computer to improve patient care.

For information contact Dr. Aziz Ghaussy, Editor of the Medical Computer Journal, 42 E. High St., E. Hampton, CT 06424, (203) 267-2934.

Aziz A. Ghaussy, M.D.
E. Hampton, CT

HELP WITH SPACING

Dear Editor:

Our system consists of a 48K TRS-80 with two disk drives and a Xerox 1700 printer. The feature that attracted us to the Xerox machine was its ability to perform variable vertical spacing or vertical motion index. Since purchasing it we have been unable to find the key to programming it for this variable spacing.

We are hoping some member of your staff may be able to offer a solution for us. If this is not possible, would you please refer us to someone who might be able to help us?

Lucy Turner
Coast Federal Savings & Loan Assn.
P.O. Drawer R
Gulfport, MS 39501

We are unfamiliar with the Xerox 1700 printer, but quite possibly one of our readers can assist you.

TRANSLATION

Dear Editor:

I have just subscribed to your magazine after reading several good articles that I may use for future reference. However, since I am a novice personal computer owner (Apple II+ 48K plus single 5" floppy), I had attempted to utilize one of several of the programs you publish only to find out that "this one's BASIC" or "that one's BASIC" is incompatible with Applesoft and therefore unusable without modifications. I simply do not have the time or expertise to make the modifications, but would like to implement these programs in my computer.

1. Could you list whether or not your program in North Star or such can be modified to Applesoft in some legend at the beginning of the article?
2. If space permits, can you indicate the changes necessary to convert the program to Applesoft?

Your comments would be appreciated.

Gerry Deddo
Villa Park, IL

Gerry, your point is well taken, and we do try to provide in all cases the version of

BASIC being used. The program is, of course, in translation. So far I have identified over 78 versions of BASIC dialects for a book I am working on. We are creating a semi-universal translation routine, and will publish it when completed.

For now I suggest you get a copy of David Lein's Encyclopedia of BASIC.

—carl

SPEEDING UP THE DECWRITER

Dear Editor:

The 600 baud DECwriter fix (INTERFACE AGE, March 1979) is great, but we noticed (1) random character drops at print position 17, particularly after returns from short lines, and (2) serious line loss on form feeds, as available in the Electric Pencil text processor and similar programs. (Our LA-36s use simple three-wire hookup, without handshaking.)

DEC's LA-36 user's manuals warn you to program delays after head or paper movement — even at 300 baud — to avoid buffer overrun and data loss. This problem increases at the higher 600 baud speed.

Instead of the programmed nulls suggested by DEC, which we found ineffective, we inserted a timed delay loop after each line feed character. Experimental adjustment of the timing constant cured the problem.

The attached 8080 code illustrates the custom driver used. The computer was a Processor Technology SOL/20 with SOLOS monitor, which contains a utility serial driver, AOUT. Values of TIME in the range 0AH to 20H work well. Another minimal serial driver can replace AOUT, as desired.

Van Court Hare, Jr.
University of Massachusetts
Amherst, MA

```
0005 DOUT  EQU   $        SERIAL DRIVER W/DELAY
0010       MOV   A,B      COPY CH FOR TEST
0015       CPI   0AH      IS IT A LF?
0020       JZ    DELAY    YES, SO SPECIAL DELAY
0025       MVI   A,01H    SELECT SERIAL DRIVER
0030       JMP   AOUT     OUTPUT NORMAL CH.
0035 DELAY MVI   A,01H    SELECT SERIAL DRIVER
0040       CALL  AOUT     OUTPUT LF
0045       PUSH  H        SAVE REGISTERS
0050       PUSH  PSW
0055       LHLD  TIME-1   GET TIME CONSTANT
0060       INR   L        MAKE IT NON-ZERO FOR SURE
0065       XRA   A        ZERO ACCUMULATOR
0070 TIMER DCX   H        DELAY UNTIL
0075       CMP   H        REGISTER H=0
0080       JNZ   TIMER
0085       POP   PSW      RESTORE REGISTERS
0090       POP   H
0095       RET   GO BACK
0100       NOP   SAVE ZERO BYTE FOR L
0105 TIME  DB    20H      TIMING PARAMETER 0-FF
0110 AOUT  EQU   0C01CH   SOLOS SERIAL DRIVER
0115       END

CAB4              0005 DOUT  EQU   $        SERIAL DRIVER W/DELAY
CAB4 78           0010       MOV   A,B      COPY CH FOR TEST
CAB5 FE 0A        0015       CPI   0AH      IS IT A LF?
CAB7 CA BF CA     0020       JZ    DELAY    YES, SO SPECIAL DELAY
CABA 3E 01        0025       MVI   A,01H    SELECT SERIAL DRIVER
CABC C3 1C C0     0030       JMP   AOUT     OUTPUT NORMAL CH.
CABF 3E 01        0035 DELAY MVI   A,01H    SELECT SERIAL DRIVER
CAC1 CD 1C C0     0040       CALL  AOUT     OUTPUT LF
CAC4 E5           0045       PUSH  H        SAVE REGISTERS
CAC5 F5           0050       PUSH  PSW
CAC6 2A D3 CA     0055       LHLD  TIME-1   GET TIME CONSTANT
CAC9 2C           0060       INR   L        MAKE IT NON-ZERO FOR SURE
CACA AF           0065       XRA   A        ZERO ACCUMULATOR
CACB 2B           0070 TIMER DCX   H        DELAY UNTIL
CACC BC           0075       CMP   H        REGISTER H=0
CACD C2 CB CA     0080       JNZ   TIMER
CAD0 F1           0085       POP   PSW      RESTORE REGISTERS
CAD1 E1           0090       POP   H
CAD2 C9           0095       RET   GO BACK
CAD3 00           0100       NOP   SAVE ZERO BYTE FOR L
CAD4 20           0105 TIME  DB    20H      TIMING PARAMETER 0-FF
CAD5              0110 AOUT  EQU   0C01CH   SOLOS SERIAL DRIVER

AOUT   C01C   0030 0040
DELAY  CABF   0020
DOUT   CAB4
TIME   CAD4   0055
TIMER  CACB   0080

CAB4: 78 FE 0A CA BF CA 3E 01 C3 1C C0 3E 01 CD 1C C0
CAC4: E5 F5 2A D3 CA 2C AF 2B BC C2 CB CA F1 E1 C9 00
CAD4: 20
```

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CIRCLE INQUIRY NO. 94

MORE SHAMBURGER

Dear Editor:

In your June, 1977, issue, page 96, you indicated that you would publish further programs by Bud Shamburger after the General Ledger series published September through November of 1977.

As a subscriber to INTERFACE AGE, and the operator of a resort apartment hotel, I am developing a similar series specifically for my operations, and could save time and benefit greatly from the anticipated articles.

Do you expect to publish the articles described in the June issue? If not, are they published elsewhere or otherwise available?

I am also writing to Mr. Shamburger. You might find space in your magazine to indicate briefly forthcoming articles.

I enjoy and use your magazine.

Bernard Plotkin
Miami Beach, FL

No, we don't plan — at least in the immediate future — to run Bud's management program. However, he has updated everything to hard disk and has been selling it quite successfully.

ON SOFTWARE PIRACY

Dear Editor:

It has come to my attention that several purportedly non-profit share-a-program clubs are actually for-profit steal-a-program companies. While I normally shrug these activities off, one is so blatantly stealing the programs of every legitimate software company and reselling them (for $2.80 each) that I thought I should alert you to them. The company is:

Trend IV, Inc.
(also known as Computer Program Users Assn.)
4122 S.W. 65th Avenue
Davie, FL 33021

They are offering virtually every TRS-80 tape from Creative Computing, Instant Software, Personal Software, Hayden, Automated Simulations, Small System Software, Quality Software, TRS-80 Software Exchange, CLOAD, Mad Hatter, The Bottom Shelf, and many others. All for $2.80 each after paying an initial membership fee of $55. Sybex self-study cassettes are also available — same price. They apparently plan to branch into Apple and PET shortly.

Given the totally unethical nature of their activities, I will not accept their advertising or run any publicity about them whatsoever. We just don't need any more World Power Systems bilking either customers or legitimate producers.

David H. Ahl, Publisher
Creative Computing
P.O. Box 789-M
Morristown, NJ 07960

CAN YOU HELP?

Dear Editor:

I am a subscriber to INTERFACE AGE and I would appreciate your help in getting answers to the following questions as soon as possible:

1. Does anyone have a REAL HI-SPEED hardwired floating point processor (single and double precision) for a Z80A, S-100 system that *really makes any significant difference in throughput*? (by a factor of 10 to 100 over say the North Star unit—*at any price?*)
2. Where can I find an in-depth evaluation article on the MARINCHIP TI 9900 16-bit system for the S-100 bus? Who/where is their source?

R.N. Tomlin
3515 Sulgrave Place
Ann Arbor, MI 48105

A FEAST OF 'LIB'

Dear Editor:

In Ray Bradbury's article "A Feasting of Thoughts, A Banqueting of Words" (June, 1978), why is it that the father chooses Shakespeare, the son selects the Hound of the Baskervilles, the daughter picks Wuthering Heights while the mother is kitchen bound with her "Cooking Witch" apparently without freedom or literary interest? By the year 2035 this will be far from normal.

With women establishing themselves in professional areas such as science, medicine, the arts and business, the idea of a "Cooking Witch" is insulting. Who needs a cooking witch when computers and robots under the guidance of a Master Chef, a talented knowledgeable homemaker, are in charge?

In the 70's a woman's choice of literature already ranges from futurist R. Buckminster Fuller's *Synergetics,* Clarke's and Bradbury's science fiction, Acquinas and Aristotle's philosophy, to Hall's *Hidden Dimensions* and Ceram's *Gods, Graves, and Scholars.*

We don't have to look forward to robots acting on stage. We already have a robot — television — which is the stage, and to some it is life itself. Maybe we should read Capek's *RUR, Rossum's Universal Robots.*

Noreen Kerr
Buffalo, NY

☆

A
HAPPY
HOLIDAY
to all of you
from all of us at
INTERFACE AGE
Bob, Nancy, Dorothy,
Dottie, Cheryl, Jean, Fino
Mike, Mary Ann, Kathy, Terry
Samantha, Melody, Charlotte, Shirley
Jetta, Kay, Carl, Terri, Dave, Rick, Julie


Seasons Greetings
to all of you
from all of us
at
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EUROPEAN MARKET GROWING

The market in Europe for small business computer systems at $1.4 billion in 1978 will increase by another $200 million this year and continue to climb thereafter to reach $4.8 billion by 1988. The cumulative market will tally $29.4 billion.

The European market for small business systems software will undergo even steeper growth. At $123 million in 1978, the software market will increase by another $44 million this year, increase to $238 million in 1980, and continue to gain each year thereafter to become a $1.7 billion market by 1988. On a cumulative basis, the market will tally $8 billion over the ten-year period.

These projections are made by Frost & Sullivan, Inc. in a new two-volume study entitled "The Small Business Computer Market in Europe" (#E265). For more information contact Customer Service, Frost & Sullivan, Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080. Ref. #E265.

CBI AWARDS FELLOWSHIP

A student in the American Studies Department at the University of Kansas, Paul E. Ceruzzi has been awarded the 1979-1980 Fellowship of the Charles Babbage Institute for the History of Information Processing.

Ceruzzi's dissertation, "The Prehistory of the Digital Computer, 1936-1946: a Cross-Cultural Study" will focus upon four unique early digital machines: the Zuse Z-3, the IBM Automatic Sequence Controlled Calculator (also known as the Harvard Mark I), the Bell Laboratory Model V and the ENIAC. He will examine the workings, programming, function and initial use of these machines.

COMPUTER RETAILERS ASSOCIATION

The "Computer Retailers Association" was formally inaugurated recently in London, England.

The purpose of the association is to maintain and improve the standards within the industry and to present the industry's case to the government and the lay press.

All companies in the industry who have a significant interest in microcomputer retailing, and expertise in software and hardware are invited to apply to join.

All potential members should contact Ms. Heather Hodgson, 47 Creswell Rd., Newbury, Berks. Telephone: Newbury 42486.

FEDERAL DISTRICT COURT RULES IN APPLE'S FAVOR

A Federal District Court in San Francisco has ruled against an antitrust claim filed by Byte Industries, and granted summary judgment in favor of Apple Computer, Inc. The court also dismissed certain other claims made by Byte, which were based on state law, without prejudice to their disposition in state court.

Apple Computer, manufacturing personal computers, terminated a distributorship agreement with Byte Industries in February 1979, resulting from Byte's failure to franchise dealers as promised. Byte then accused Apple of violating federal antitrust laws.

The court ruled that, "Apple's termination of Byte's distributorship agreement was effected by Apple unilaterally for valid business purposes, and without any anticompetitive intent or effect. . .The actions alleged, and the evidence adduced by Byte in support of its allegations, do not constitute a contract, combination or conspiracy in restraint of trade within the meaning of Section 1 of the Sherman Act, 15 U.S.C., Section 1."

Byte has appealed the ruling to the Ninth Circuit Court of Appeals in San Francisco.

SOUTH AMERICAN CLUB

A Brazilian TRS-80 User's group wants to receive information from suppliers (both hardware and software), and exchange programs with other groups. They are also interested in TRS-FORTRAN programs and CP/M.

Contact Douglas Gilson, Rua Sambaiba 516, Leblon, Rio de Janeiro 22450 Brazil.

D/P JOBS INCREASING

According to a just-completed '79 annual nationwide survey of data processing job/salary conditions conducted by Fox-Morris Personnel Consultants, one of the nation's "Big Five" recruitment leaders, demand for programmers and analysts has reached all-time record levels.

The need for application programmers has skyrocketed 41% higher in '79 than one year ago, and 35.1% higher for software and systems programmers, according to the survey.

Close behind in demand are systems analysts. Need for these personnel is up almost 29% this year from '78, the survey shows.

Other high-demand specialists include telecommunications personnel (up 21.3% over '78 demand), EDP Auditors (up 20%), and Senior Programmer Analysts (up 18.2%) and various managerial and executive-level talent.

AIDs FOR APPLE DEALERS

A new organization has been formed by and for independent Apple Computer dealers. It is called AIDs (Apple Independent Dealers). The education of dealers, employees and their customers will be the primary goal.

Full membership for qualified dealers is $35 per year, with a $15 initiation fee for new members. For more information contact Harry M. Sweeney, President, at (503) 228-5242, or send an S.A.S.E. to AIDs, P.O. Box 06126, Portland, OR 97206.

CIRCLE INQUIRY NO. 3

SUMMER COMPUTING PROGRAM

A "Summer Computing Institute" at Tulane University, for students ranging from high school to college graduate level, will offer a variety of computing courses.

Courses include: Introduction to Computing 1 & 2; Business-Oriented Programming, which emphasizes BASIC and COBOL; Introduction to Assembly Languages, and Higher-Level Languages — PL1, APL, ALGOL, Pascal, and comparisons of their respective uses and benefits for users.

Tulane provides the books, access to Digital Equipment Corporation PDP-11 and DECSystem 20 computer systems, and several hours of lecture material for a tuition fee of $650.

For more information contact Dr. Victor Law, Chairman, Computer & Information Systems Dept., School of Engineering, Tulane University, New Orleans, LA 70118.

MICROS IN EDUCATION

A non-threatening first experience with microcomputers for K-12 teachers is the goal of a research and development project at the University of Oregon.

The project is based on the idea that it is not necessary to know how to program to make good use of a microcomputer as an instructional tool in the classroom.

In the University's self-instructional, laboratory-type course, the learner will have access to a PET microcomputer and a library of more than 50 programs to explore, including materials at various levels in Fine Arts, Business, English, Foreign Language, Consumer Economics, Industrial Arts, Mathematics, Science and Social Studies.

The program, piloted this fall, should be released in the summer of 1980 for use by other educational institutions.

MANAGEMENT SEMINARS

"The Senior Executive Overview and The Management Seminar," both focusing on successful management of computer facilities and information systems in the 1980s, are scheduled to tour the nation.

The Senior Executive Overview will discuss major trends and techniques for managing computers; treating information technology as a corporate resource, and more.

The Management Seminar discusses these trends and techniques in more detail and includes supervising and planning automated facilities and operations, test and control of computer operations, and more.

The one-day Senior Executive Overview will be held in Washington, December 3; Fort Lauderdale, December 10; and other cities. The two-day Management Seminar will be presented in Washington, December 4-5; Fort Lauderdale, December 11-12; and other cities.

For more information contact CPM Corp., Box 1403, Rockville, MD 20850.

VIDEOTAPE MICRO COURSE

A videotaped course entitled "Introduction to Microprocessors for Monitoring and Control," comprised of sixteen 30-minute color videotapes, is designed for engineers and scientists who want to learn logic design and how to implement a design on a microprocessor.

The course is offered by Colorado State University's Engineering Renewal & Growth program and stresses the use of algorithms where most people make their mistakes in digital design. MST-80B Microcomputer Trainer, individual study guide and textbook supplement videotapes.

For more information contact W.L. Somervell, ERG Director, Christman Field, Bldg. 1000, Colorado State University, Ft. Collins, CO 80523.

FIBER OPTIC ADVANCES

An in-depth report by International Data Corporation on fiber optics has recently been published. The 6-chapter report covers fiber optics thoroughly, but in layman's terms for the nontechnical executive.

The report gives an explanation of the breakthroughs of optical communication. It also delineates how fiber optics works, its possible and present applications, market projections and current suppliers.

For details contact Mary Trayte, Circ. Mgr., International Data Corp., 214 Third Ave., Waltham, MA 02254.

CIRCLE INQUIRY NO. 60

the Column

By Henry Wurzburg
Auto. Sys. Eng., Motorola
Mesa, Arizona

The ability to generate graphics may often be a useful addition to a microprocessor system. The program shown in Figure 1 provides this capability in a minimum amount of software. It stores any console generated graphics in memory and also copies into memory the object code for the "read-back" program.

The only limitations on the size of the graphic area are the size of available memory and the console printer format. The program is intended for use in an M6800 system and utilizes subroutines stored in an EXbug® operating-system ROM.

Starting at address $2000, the program first loads the read-back program's object code at address $0000 and then waits for, accepts, and stores keyboard character entries into the memory following the read-back program.

The program will continue accepting characters until "CNTL EOT" (ASCII $04) is received, at which time it will print the beginning address ($0000) and ending address of the graphic data string just generated. The program then exits to EXbug monitor program MAID.

At this point the graphic may be printed by starting execution at $0000 or may be stored on a permanent storage medium (tape, disk, etc.). An example of printout is shown in Figure 2.

The program will allow approximately 8K words of character storage before overwriting itself. This can easily be adjusted by organizing the program either higher or lower in memory as required.□

PROGRAM LISTING

```
PAGE  001    GRAPHICS

                               NAM    GRAPHICS
                               OPT    NOP
                        *GRAPHICS GENERATOR PROGRAM
                        *STORES CONSOLE GENERATED GRAPHICS AND COPIES
                        *READ-BACK PROGRAM INTO MEMORY STARTING AT LOC 0000.
                        *START EXECUTION AT LOC$2000.ENTER GRAPHIC DISPLAY
                        *ON SYSTEM CONSOLE.END WITH (CTRL EOT)
                        *ENDING ADDRESS OF DATA FILE AND READ-BACK
                        *PROGRAM WILL BE PRINTED.GRAPHIC
                        *MAY NOW BE STORED FOR FUTURE USE
                        *OR PRINTED OUT BY STARTING EXECUTION AT 0000.
                        *
                        *
                        *
                        *
                        *
             F021       PCRLF  EQU    $F021    LOC OF CR/LF EXBUG ROUTINE
             F015       INCHNP EQU    $F015    LOC OF INPUT ROUTINE IN EXBUG
             F018       OUTCH  EQU    $F018    LOC OF OUTPUT ONE CHARACTER
             F027       PDATA1 EQU    $F027    LOC OF OUTPUT STRING IN EXBUG
             F009       CHEXL  EQU    $F009    LOC OF ASCII CONV IN EXBUG
             F00C       CHEXR  EQU    $F00C    LOC OF ASCII CONV IN EXBUG
                        *
                        *
                        *
       2000                    ORG    $2000
       2000 8E 2052            LDS    #TAB-1   START OF READ-BACK PROG TABLE
       2003 CE 0000            LDX    #$00
       2006 32          AA     PUL A
       2007 A7 00              STA A  0,X      COPY READ-BACK PROGRAM
       2009 08                 INX
       200A 8C 000C            CPX    #$0C
       200D 26 F7              BNE    AA       FINISHED LOADING READ-BACK  ?
       200F 8E 20B1            LDS    #$20B1   MOVE STACK POINT OUT OF WAY
       2012 BD F021            JSR    PCRLF    CARRAGE RETURN AND LINE FEED
       2015 BD F015 BB         JSR    INCHNP   INPUT GRAPHICS DATA
       2018 A7 00              STA A  0,X      STORE DATA TO MEMORY
```

Upgrade your Level II TRS-80 and brighten your programming without the cost of a Radio Shack expansion interface and disk drives.

Microsoft's Level III BASIC is an enhancement to the Level II, loading from a cassette tape right on top of the Level II ROM. It contains all Disk BASIC features not already in Level II, except for file management commands. And it adds six new Level III exclusives not available in Level II or Disk BASIC.

No one knows better than Microsoft how to increase your TRS-80's BASIC power. Microsoft created the TRS-80 Level II and Disk BASIC plus the industry standard Microsoft BASIC.

Advanced graphics is Level III's most exciting addition to the TRS-80—and it's exclusive. Draw a line, outline or solid box by specifying just two points, then save it and put it back with BASIC statements. You'll find yourself writing more programs with charts, graphs and even animation.

Other Level III exclusives include 26 user-definable single stroke instructions so you can enter any command, statement or string with a shift-key entry. New SAVE and LOAD commands improve the reliability of loading tape programs by eliminating problems with cassette recorder volume sensitivity. Aggravating keyboard bounce is also eliminated. INPUT # LEN and LINE INPUT # LEN statements allow you to write programs with a time limit. And, joy of joys, Level III has automatic line renumbering.

TRS-80 power increases with Level III's seven Disk BASIC features. Ten user-defined subroutines can be used in a program. Error messages are spelled out. LINE INPUT instruction accepts punctuation marks within a string and eliminates the automatic "?" from the INPUT prompt. A more flexible MID$ increases string manipulation power. INSTR function searches a string for a specified substring. And Level III performs hex and octal conversion.

Level III even adds new capabilities to a TRS-80 system with an expansion interface by outputting to the RS-232 port in BASIC and setting and reading time and date from BASIC.

Level III occupies only 5.2K RAM with something for every TRS-80 from the 16K Level II minimum system requirement and up. It can be stored on disk as a file, but it only works in conjunction with Level II; it will not operate with Disk BASIC. Programs written in Level III BASIC are stored on cassette tape.

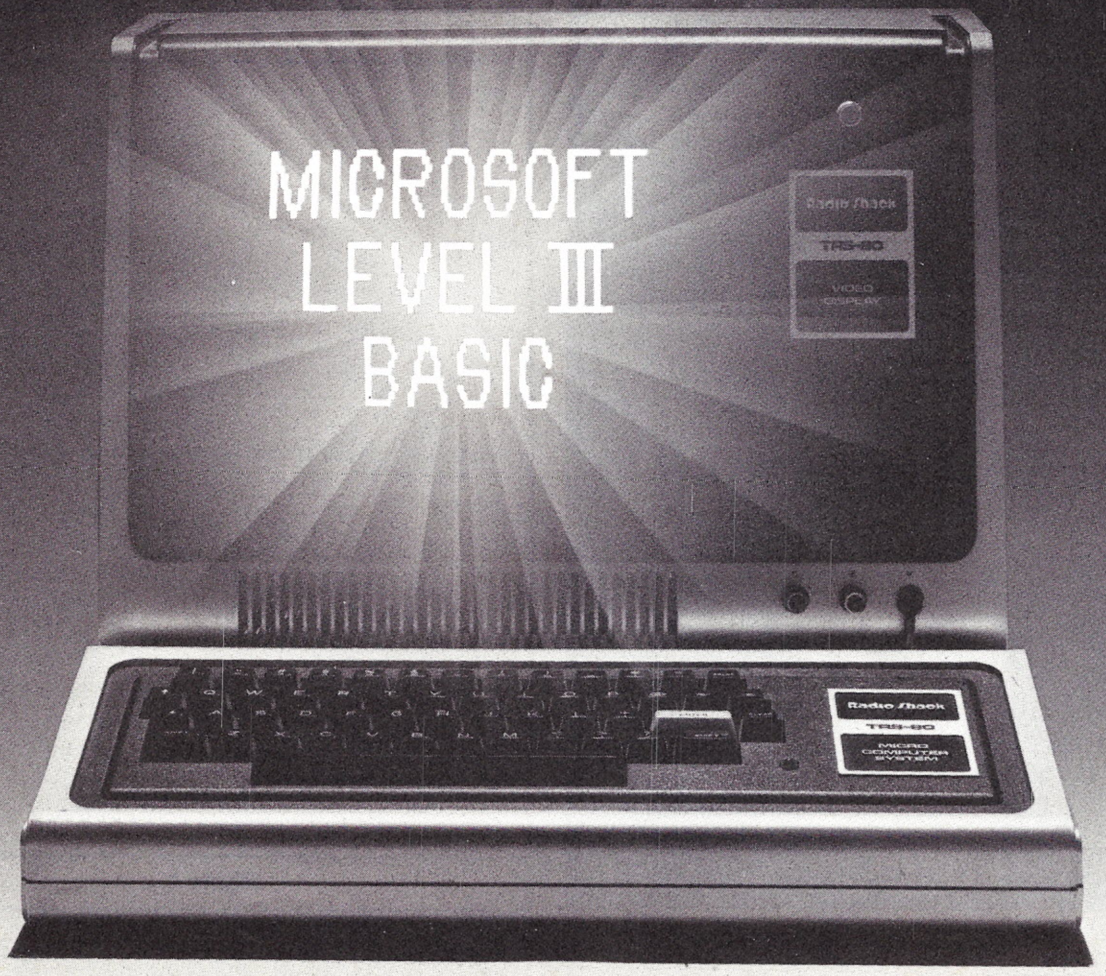
The users manual is full of how-to-use descriptions, sample programs and a complete graphics section. The reference card provides a quick-find list of commands, statements, functions and other Level III features. Manual, reference card and Level III cassette tape for only $49.95.

Microsoft Level III BASIC is sold at Computer retailers nationwide. If your local computer store doesn't have Level III, ask them to call us. You can call us, too, for the name of your nearest Microsoft dealer. Phone (206) 454-1315. Or write Microsoft Consumer Products, 10800 Northeast Eighth, Suite 819, Bellevue, WA 98004

MICROSOFT
CONSUMER PRODUCTS

CIRCLE INQUIRY NO. 54

Now! The most powerful TRS-80 BASIC you can buy, from the #1 name in microcomputer system software.



```
201A 08                INX
201B 81 04             CMP A  #$04      IS DATA EOT?IF SO, FINISHED.
201D 26 F6             BNE    BB        IF NOT FINISHED,NEXT INPUT
201F BD F021           JSR    PCRLF     CARRAGE RETURN AND LINE FEED
2022 09                DEX
2023 FF 20A4           STX    INDEX     STORE ADDRESS OF LAST DATA
2026 CE 205F           LDX    #MES      POINT TO END OF PROG MESSAGE
2029 BD F027           JSR    PDATA1    PRINT MESSAGE
                *THE REMAINDER OF THE PROGRAM ADJUSTS THE ENDING
                *ADDRESS OF THE GRAPHIC DATA STRING TO ASCII AND
                *PRINTS IT OUT.

202C B6 20A4           LDA A  INDEX
202F BD F009           JSR    CHEXL
2032 BD F018           JSR    OUTCH
2035 B6 20A4           LDA A  INDEX
2038 BD F00C           JSR    CHEXR
203B BD F018           JSR    OUTCH
203E B6 20A5           LDA A  INDEX+1
2041 BD F009           JSR    CHEXL
2044 BD F018           JSR    OUTCH
2047 B6 20A5           LDA A  INDEX+1


204A BD F00C           JSR    CHEXR
204D BD F018           JSR    OUTCH
2050 7E F0F3           JMP    $F0F3     GO TO EXBUG MAID PROG
                *
                *
                *
                *
                *
                *THIS TABLE CONTAINS THE OBJECT CODE FOR THE
                *READ-BACK PROGRAM
2053 BD         TAB    FCB    $BD,$F0,$21,$CE,$00,$0C,$BD,$F0
205B 27                FCB    $27,$7E,$F0,$F3
                *
                *
                *
                *THIS TABLE CONTAINS THE END OF PROGRAM MESSAGE
205F 42         MES    FCC    *BEGINNING ADDRESS OF THE GRAPHIC *
2080 4A                FCC    *JUST GENERATED IS 0000,*
2097 20                FCC    * IT ENDS AT *
20A3 04                FCB    04
20A4 0002       INDEX  RMB    2
     0000              END

TOTAL ERRORS 00000
```

Figure 1.

```
*2000;G

                 XXXXXXX
             XXXX       XXXX
           XX               XX
          X                   X
          X                   X
           X                 X
            X               X
             X             X
              X           X
               X         X
          XXXXXXX       XXXXXXX
             □             □
            □ □           □ □
             □             □

               A MOBILE OHM!

BEGINNING ADDRESS OF THE GRAPHIC JUST GENERATED IS 0000,
IT ENDS AT 028E
*0000;G

                 XXXXXXX
             XXXX       XXXX
           XX               XX
          X                   X
          X                   X
           X                 X
            X               X
             X             X
              X           X
               X         X
          XXXXXXX       XXXXXXX
             □             □
            □ □           □ □
             □             □

               A MOBILE OHM!
```

Figure 2.

THERE IS A DIFFERENCE IN TRS-80 DISK DRIVES CAPACITY

Expansion interface – gives your TRS-80 the disk capacity it needs, and much, much more!

10 to 40 MByte, 8" Winchester drive – expands capacity far beyond Model II storage.

Single sided minifloppy – up to 150 KBytes of storage capacity.

Single or double sided 8" floppies – up to 2.5 MBytes in dual drive cabinet – for the serious TRS-80 user.

LOBO DRIVES' new family of disk memory products provides you with a choice of memory capacities you need to effectively execute the complex business software you've developed for your TRS-80*. LOBO DRIVES' selection of readily available, software compatible drives permits you to expand your inventory, payroll, customer list, and accounts receivable files as your business grows.

And LOBO DRIVES brings you more . . . a new plug-in expansion interface that provides an easy way to add hardware enhancements, communications capability, and programmable features . . . and it comes with the LOBO DRIVES famous 1 year, 100% parts/labor warranty.

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TR-2

Yes, I want to know more about LOBO Drives and what they can do for my TRS-80. Send me information on:

- ☐ 5 1/4-in. Floppy drive
- ☐ 8-in. Winchester hard disk, 10 Mbyte drive
- ☐ 8-in. Floppy drive Single sided Double sided
- ☐ Double density expansion interface

Name ____________________

Company ____________________

Address ____________________

City __________ State __________ Zip __________

Phone No. ____________________

If dealer, provide resale no. ____________________

*TRS-80 is a registered trademark of Radio Shack, a Tandy Company.

CIRCLE INQUIRY NO. 47

CALENDAR

SCIENCE AND MATH CONFERENCE

"Science and Math Education Through the New Information Technologies" will be held in Tarrytown, New York on November 8 and 9.

This conference, sponsored by WICAT Incorporated under a grant from the National Science Foundation, will disseminate information about microcomputer, videodisc and videotape technologies to science and math educators, government and industry officials, school board members, and science writers in the New York area.

For more information contact WICAT, Room 29E, 111 E. 85th St., New York, NY 10028, (212) 876-1144.

MICROPROCESSORS IN SYSTEM DESIGN

A seminar for upper and middle management, systems analysts, project managers, design engineers, and engineering support staffs, who find that microprocessor-based systems and subsystems are playing an increasingly large role in their specialties will be offered by the Institute for Advanced Technology on the following dates:

November 12-14	New York
December 17-19	Washington, D.C.
January 21-23	San Francisco

Microcomputer units will be used to provide practical experience with the capacity of microprocessors to solve specific design problems.

For more information contact Darlene Promowicz, Registrar, Institute for Advanced Technology, 6003 Executive Blvd., Rockville, MD 20852.

"HOW-TO" SEMINAR EXAMINES INTEGRATED LOGISTICS SUPPORT

A how-to seminar designed to help identify and solve integrated logistics support problems for the aerospace and defense industries will be held November 29-30 in Los Angeles, California.

Sessions will focus on the increasingly important integrated logistics support area. Topics such as ILS in the system acquisition process, the ILS elements and disciplines, proposals and source selection, and systems supportability will be covered.

For details contact Sole/TMSA Seminars, Department ILS, P.O. Box 91295, Los Angeles, CA 90009.

MODCOMP CONFERENCE

The Modcomp Users Exchange (MUSE) will hold its fifth annual conference December 2-6 at the Bahia Mar Hotel and Yachting Center in Fort Lauderdale, Florida.

The conference will feature technical sessions, workshops and user/manufacturer interface sessions on the use of Modcomp computers and their related software. Hardware and software information booths will be open throughout the conference.

For information contact Kathy Black, Modcomp User Exchange, 4620 W. Commercial Blvd., Suite 6C, Tamarac, FL 33319, (305) 485-8270.

AGA SYSTEMS CONFERENCE

The Association of Government Accountants (AGA) will sponsor a National Conference of Information Systems on December 3-5 in Washington, D.C. The meeting will address the theme "Information Systems As A Management Tool for the Financial Executive."

Technology update sessions will be offered along with discussion of major issues in the application of modern computer technology to accounting systems.

For details contact Ken Burroughs, DBD Systems, Inc., 1500 N. Beauregard St., Alexandria, VA 22311, (703) 820-3319.

PASCAL WORKSHOP

Polytechnic Institute of New York and the Institute for Advanced Professional Studies are presenting an intensive seminar for engineers, programmers, and technical managers.

"Pascal Programming for Mini and Microcomputers" will be held on December 3-7 at the Holiday Inn, Palo Alto, CA and on April 25-26, May 1-3, 1980 at the Polytechnic Westchester Center, White Plains, New York.

Tuition is $600 and includes extensive course notes, text, and evening reception. For details contact Professor Donald D. French at (617) 964-1412 or the Institute for Advanced Professional Studies, One Gateway Ctr., Newton, MA 02158.

WANG CONFERENCE

Wang Laboratories Inc. will sponsor its annual International Conference for Wang Users at the Sheraton-Boston Hotel, December 3-6.

Interested parties can contact Doug Belnap, conference coordinator, at (617) 851-4111 for more information.

WEST COAST SHOWS

California Computer Show will be held December 9 at the Hyatt Cabana Hotel in Palo Alto, California. A second California Computer Show will be held March 13, 1980 at the Inn At The Park in Anaheim, California.

OEM and end-user computer and peripheral products will be exhibited and demonstrated at both shows. For details contact Norm De Nardi, 95 Main St., Los Altos, CA 94022, (415) 941-8440.

DATA PROCESSING SEMINAR

Management Information Corporation presents a two-day seminar specifically designed to meet the needs of company management in understanding computers. The Data Processing for Businesspeople Seminar includes basic concepts of data processing, major data processing applications, small business computer systems, program packages availability and selection and the future of data processing.

The course will be held at the Cherry Hill Inn in Cherry Hill, New Jersey on December 8-9, 1979.

The price of the course for MIC subscribers is $295 and for non-subscribers is $315. For information contact Management Information Corp., 140 Barclay Ctr., Cherry Hill, NJ 08034, (609) 428-1020.

ADVANCED PROGRAMMING WORKSHOP

A new 5-day hands-on advanced programming workshop has been announced by Wintek Corporation.

Course objectives include developing those skills required to plan, prepare, test and document microprocessor applications software. Lab projects will include using assemblers and high level language compilers and interpreters.

The course is scheduled for December 10-14 in Lafayette, Indiana. For details contact Wintek Corp., 902 N. 9th St., Lafayette, IN 47904, (317) 742-6802.

MICROCOMPUTERS & PHYSICS

The joint meeting of the American Association of Physics Teachers and the American Physical Society to be held at the Chicago Marriott Hotel, January 21-24 will have several sessions dealing with microcomputers and instrumentation.

Included are all-day workshops on "Introduction to Microprocessors," and Pascal programming language, and a hands-on session "The Use of Personal Computers in Learning Physics."

For more information contact American Association of Physics Teachers, Graduate Physics Bldg., SUNY at Stony Brook, Stony Brook, NY 11794, Attn: Joint Meeting, (516) 246-6840.

VOICE & DATA COMMUNICATIONS CONFERENCE

Communication Networks '80, the first major national voice and data communications conference of the decade, will be held on January 28-30 at the Sheraton Washington Hotel.

Technology sessions will bring out the latest in telecommunications by tutorials in new areas such as fiber optics, satellite communications, systems networks and more.

CN '80 is produced by The Conference Company. For more information contact Conference Director William R. Leitch at (800) 225-3080.

SCHEDULE DESIGN COURSE

"Scheduling Work Shifts and Days Off for Employees of Extended-Hours Services" course centers around the design of employee work schedules to meet management's productivity objectives and satisfy employee preferences and needs.

The seminar features hands-on use of new low-cost microcomputers and programmable calculators.

The Institute for Public Programs Analysis will hold this training program February 4-8 in St. Louis, Missouri. For details contact TIPPA, 230 S. Bemiston, Suite 914, St. Louis, MO 63105, Allen Gill, Registrar.

From the Fountainhead

By Adam Osborne

I spent much of 1978 predicting that 1979 would be a **year of transition** for the microcomputer industry. I predicted that companies who put their financial houses in order would survive and prosper, while the others struggled into oblivion or bankruptcy.

In the USA, that is exactly what happened. I believe it is already too late for any manufacturer of microcomputer hardware to find venture capital at reasonable terms. A few microcomputer hardware manufacturers — very few — are doing extremely well. They got their management and finances in order while they could. But the rest had inflated ideas of what their companies were worth; and in consequence, their companies already are, or soon will be worth little.

Those microcomputer hardware manufacturers who are still struggling from month-to-month with cash flow problems have a bleak future. If they are to survive at all, these companies should retrench into small operations, selling specialized products, but doing it well. Otherwise they will soon be out of business. Under no circumstances can microcomputer system manufacturers expect to survive much longer, offering a broad range of products, unless they already have sound finances and general management.

I visited **Apple Computer Corporation** recently, and nothing brought the changed times home to me more dramatically than this visit. Apple is no longer a small company. It is a medium sized company, run by a group of hard-nosed professionals who could probably run any electronics company successfully. And yet, three years ago, I sat next to Steve Jobs and Steve Wozniak at a meeting of the Home Brew Computer Society, at Stanford Linear Lab in Palo Alto, and I watched them explain to other hobbyists, with much enthusiasm, their new single board computer — destined to become the Apple I.

Those were exciting days, but those days are gone, and it would be advisable if we all understood the changes that have occurred.

Time was when you could advertise a product that did not exist, secure in the knowledge that your customers would accept it — with design errors, no documentation, no software nor hope of service. Your customers would grumble, but they would accept it; but no longer. Mike Markkula of Apple explained to me that Apple frequently has working hardware for six months before they start to ship it, because that is how long it takes to provide the hardware with adequate documentation. What chance does any Apple competitor have who offers less?

Texas Instruments is introducing the 99/4 personal computer; it will be serviced by the world-wide Texas Instruments service organization. Competitors who offer less should worry.

The **market for small computers** has grown because of a large, new customer base that was wooed and won with promises. And if the small computer industry is to survive, it must now deliver on its promises. The new customer base looks upon the computer as an appliance that should work all of the time. It is not a kit to be assembled and tinkered with by technically sophisticated whiz-kids.

Yet, in the past, the personal computer industry has provided a level of support for its products that was shoddy, even by the prior shoddy standards of the minicomputer industry. Now the personal computer industry is making a fast transition, to the point where their standards will far exceed anything the entire computer industry has seen before.

If, in the past, you bought a computer system, legally you owned the system; but for all practical purposes the manufacturer continued

to own it, because the moment anything went awry, you were screaming to the manufacturer for help. The computer was on your premises, but few people in your organization understood enough about it to do more than operate it.

That scheme worked when computer systems cost $50,000 and up. The profit margin in such a system was sufficient for the manufacturer to expect some customer relations expenses, and set money aside to meet these expenses. But a personal computer that costs a few hundred to a few thousand dollars is an appliance. The only way a manufacturer will make money selling products at these prices is to follow the example of the television industry, documenting clearly those things that computer owners must do for themselves and providing fast local service to cope with everything else.

But this approach will require far more documentation than the television manufacturer provides, since the typical small computer owner can and should be responsible for a significant level of preventive and corrective maintenance. The inside of a small computer is simpler and safer than the inside of the average television set.

In consequence, the **changes we have seen** in 1979 will continue, and even accelerate through 1980. Surviving companies will then offer documentation and product support that surpass the best we have seen from Hewlett-Packard or Heathkit. Those who offer anything less will no longer be around.

Microcomputer users must become even more critical of bad software, documentation and support, because acceptable products are available now, and they are getting better.

When you buy a personal computer, the **documentation** you receive should lead you by the hand through installation and operation. It should tell you how to diagnose and fix simple hardware failures. Software documentation should explain how to program the computer. Documentation should be written for the dumbest of the new customer base; because it is this broad customer base that made the industry grow to its present size. Documentation should not be written for the technically elite who can decipher incomprehensible literature based on their prior knowledge of computers.

The **software** that comes with your personal computer should be reliable; it need not be full of features. The average small computer user is far more interested in software that works all the time than he is in software that includes the most recent and obscure disk operating system enhancements.

Customers who get anything less than this level of documentation, software and support should scream about it! Because the louder you scream, the sooner you will get what you need, and the longer you are silent, the more you will have to put up with inadequacy.

To the **budding entrepreneur,** all is not lost, however. Some windows have closed, but others are opening. The days are gone when hobbyists could run advertisements for nonexistent products, and with no investment build sizable companies. But if you are less ambitious, the future is still bright.

Do not attempt to design a new microcomputer system; such a venture will surely fail. But seek to combine your specialized knowledge, in whatever field it may be, with your knowledge of microelectronics. There the future could be as bright as it has ever been.

Who knows what new domestic or commercial product may result from the combination of microelectronics and your specialized training? Do not put microelectronics into products which already exist today — think instead of video games, a product whose very existence depended upon the advent of microelectronics.

In the future, the successful microelectronic-based products will be new products that exist because of microelectronics; they will not be products that used to exist, but now contain microelectronics.

If you are aiming high and plan to make a lot of money, then stick to hardware. On the other hand, if your primary goal is to have fun, if you have little money to invest and expect few profits in return, then try software. Because, as I stated last month, there is no solution to the problem of software theft, your programs will be stolen when they should have been paid for. The moment a software company tries to grow too large in today's environment, it will fail.

The message for the next few years, then, is that the opportunities still abound, but they differ from the opportunities that we have seen in the past.☐

The views in this column are those of the author and are not necessarily those of the magazine or its staff. Dr. Osborne may be contacted at P.O. Box 2036, Berkeley, CA 94702.

CIRCLE INQUIRY NO. 30

JURISPRUDENT COMPUTERIST

By Leonard Tachner
Attorney-at-Law

THE VALUE OF A PATENT APPLICATION

It is well known that an issued U.S. patent gives its owner the right to exclude others from making, using and selling the claimed invention. However, a pending patent application that has not yet been allowed by the Patent Office provides no such protection to the inventor. The owner of a patent application has no immediate remedy against alleged infringers unless he's been issued a patent. However, patent applications still have substantial value.

COMPLETES PROCESS OF INVENTION

The process of filing an application that meets all the legal requirements for Patent Office acceptance constitutes a step in the inventive process. As an illustration, assume an engineer conceives a very advantageous, useful, and novel system and completes a thorough paper design in the form of detailed schematics, assembly drawings and a written description.

However, for economical reasons, the company for which he works decides to delay all efforts to reduce his system to practice until the market is more receptive to mass sales of such a system.

Mere conception of an invention, even to the extent of completing detailed drawings such as those mentioned above, is not a complete process of invention as defined under the patent law. This may be especially important because the patent law specifies that only the first to invent is entitled to a patent.

Therefore, if two individuals who are acting independently conceive the same invention at roughly the same time, the question of who is entitled to the patent usually depends upon who was the first to complete the process of invention. This requires that the invention either have been actually or constructively reduced to practice. The filing of a patent application is construed under the law as constructive reduction to practice. Accordingly, if our inventor never actually reduced his invention to practice by building a working system, then the act of filing the application constitutes the necessary completion step in the process of invention.

BARGAINING POWER

A patent application is also a valuable asset insofar as contractual relations are concerned. The value of this asset became commonly known in a recent U.S. Supreme Court case entitled "Aronson versus Quick Point Pencil Company." Mrs. Aronson had invented a new form of keyholder and had filed a patent application on that keyholder. Eight months later, while her application was still pending, she negotiated a contract with the Quick Point Pencil Company. They were to manufacture and sell the keyholder under an exclusive agreement and pay Mrs. Aronson a royalty of 5% of the selling price.

The contract specifically provided that if the patent application on the keyholder was not allowed within five years, the royalty rate would be reduced to 2½% of sales as long as Quick Point continued to sell the keyholder. Her application was denied by the Patent Office and abandoned, but she continued to receive her royalty payments as specified by her agreement until September, 1975, when this dispute arose. By that date, Mrs. Aronson had received royalties totaling $204,000.

Roughly twenty years after the contract between Mrs. Aronson and Quick Point had been executed, Quick Point stopped paying royalties under the agreement and brought a suit for declaratory judgement in Federal Court, asserting that state law under which the contract

would otherwise be enforceable was preempted by the federal patent law. Quick Point argued that Mrs. Aronson's inability to obtain a patent on her keyholder precluded the payment of royalties under the contract.

The district court found in favor of Mrs. Aronson holding that the contract was valid and that Quick Point was still obligated to pay royalties. However, Quick Point appealed and the Court of Appeals reversed the lower court's decision.

The Supreme Court again reversed, finding that the contract was enforceable and that the applicable state law was not preempted by the federal law. It found that permitting inventors to make enforceable agreements licensing the use of their invention in return for royalty payments was an additional incentive of invention and not a substitute to the patent system.

Quick Point had argued that if Mrs. Aronson has succeeded in obtaining a patent, she should have been entitled to her 5% royalty on the keyholders sold only during the 17-year life of the patent. Therefore it was illegal for Quick Point to have to pay the 2½% royalty without any express time period in their agreement.

The court ruled that Quick Point had the advantage of utilizing Mrs. Aronson's keyholder design without risk of legal liability. This advantage had enabled it to preempt the market and earn a substantial profit, as reflected by the large payment of royalties to Mrs. Aronson. In specific regard to the value of a pending patent application, the court stated:

> "No doubt a pending application gives the applicant some additional bargaining power for purposes of negotiating a royalty agreement. The pending application allows the inventor to hold out the hope of an exclusive right to exploit the idea, as well as the threat that the other party will be prevented from using the idea for 17 years. However, the amount of leverage arising from a patent application depends on how likely the parties consider it to be that a valid patent will issue."

PRESERVES RIGHTS TO FOREIGN PATENTS

Another value of a patent application is that its filing often preserves the right to later file corresponding applications in foreign countries. A U.S. patent provides the right of exclusion only in the United States. Therefore, important inventions that have strong market potential in foreign countries must be protected by a separate patent in each country.

The United States patent laws give the owner of an invention the right to test the marketplace by selling his invention for up to one year before applying for his patent. He will otherwise be barred forever from obtaining patent protection on that invention. However, most foreign countries do not provide such a hiatus, instead requiring that an application be filed before the first public disclosure.

Thus the invention owner is faced with a large investment for filing in foreign countries before having the opportunity to assess the commercial merits of his invention. Fortunately, the United States and most foreign countries have agreed to give foreign nationals of participating countries credit for their first filing date as long as they file in foreign countries within one year of the first filing date.

For example, a U.S. company may file a patent application of its invention on January 15, 1980, making a relatively small investment compared to the cost for filing in numerous foreign countries. This company then has until January 15, 1981 to file corresponding patent applications in foreign countries. In the meantime, that company may use virtually all of 1980 to assess the market potential of its invention anywhere in the world without losing its right to a patent.

CONCLUSION

A patent application filed in the United States Patent and Trademark Office creates certain additional value by completing the process of invention through a constructive reduction to practice. It also gives bargaining power for purposes of negotiating a royalty agreement and by preserving a U.S. applicant's right to file in foreign countries for one year.

Next month we will discuss the requirements for filing a proper patent application. It will lead into a new format for this column in future issues in which issued patents in the computer arts will be analyzed.☐

The material presented in this column is intended for the reader's general information. The author requests that professional advisors be consulted prior to applying this material to a specific situation. For further information contact the author at the law firm of Fischer and Tachner, 2192 Dupont Drive, Suite 210, Irvine, CA 92715.

AL BAKER'S GAME CORNER

By Al Baker

Computers were invented to play games. People used lots of excuses to convince other people to pay for building them, but we know that those reasons are no fun at all. Large companies have large computers so that they can print paychecks. So they say. The real reason is so that the people in the computer department can play Star Trek.

Now that everybody can afford their own computer, we don't need excuses anymore. We can buy a computer to play with. When someone asks "What are you going to do with it?!" stand up straight, look him in the eye and announce, "I'm going to have a ball!"

And that's why this series is here, to help you have a ball with your computer. Each month, I will take one of the popular computers and write a short game that will show off that computer's best features. I will also help you tear the game apart and use the pieces to create your own games.

THE ATARI 400

This month we are going to use the Atari 400. The game we are going to play has been popularized by Milton-Bradley with Simon and Parker Brothers with Merlin.

For those of you who haven't played with these delightful toys, here are the rules of the game. First, the computer flashes a color along with a musical note. You must repeat the same note. If you succeed, the computer replays the original color and note and then adds another. Now you must repeat both notes. If you do, then the computer adds a third, and so on. Eventually, you will forget the pattern of notes and miss. Then, you or the next player will have to start over. On the Atari, you select the correct note by using joystick #1.

Here is how the game is put together. Lines 70 through 110 define the four notes and lines 140 through 220 describe the four colors. There are 256 possible colors on the Atari 400 and these are the closest I have found to pure red, blue, yellow and green.

Lines 270 through 420 set up the TV screen. One of the nicest features of the Atari 400 is the large letter set. Graphics 18 lets you place twelve lines of these large letters on the TV in four different colors. But you can't use the normal PRINT statement to put these letters on the screen. Instead, use PRINT#6;. This works fine.

I said you can put the letters on the screen in four different colors, but doing it is tricky. To use the first color, print on the screen using normal upper case letters. This was done in line 360. To use the second color, print using lower case letters. The word "red" is in lower case in line 380. To use the third color, go back to upper case, but use the Atari key on the keyboard to print the letters in reverse video. In the listing, I show this by putting a box around the word "BLUE" in line 400. To use the fourth color, use the Atari key and print the letters in lower case. The word "green" in line 420 is in reverse video lower case.

The game is played from line 450 to line 760. Between line 480 and line 560, the computer adds a new note and plays the entire tune. From line 590 to 760, it picks up the player's notes. If the player is correct, the computer reverses the brightness of the background for a second in lines 624 to 628 and then goes back and adds another note to its tune. If the player is wrong, the computer gives him a Bronx cheer and flashes the screen at him. This is done in lines 680 to 720.

Now it is time to explore two other features of the Atari 400: the ability to change colors and play chords of music. Each of the four large words are put on the screen using a different color register. Before printing them, the computer sets all of the color registers to black. In line 2040, it changes the color register of the chosen word to the correct color. In line 4040, it resets the color register to black. This is how the computer flashes the color word on the screen.

An Atari computer has four separate sound registers. This means it can play chords. In lines 2000 through 2030, the computer uses three of these sound registers to play the major chord of the chosen note. You can use these same equations to take any note on the Atari and make it sound like it is being played on an organ.

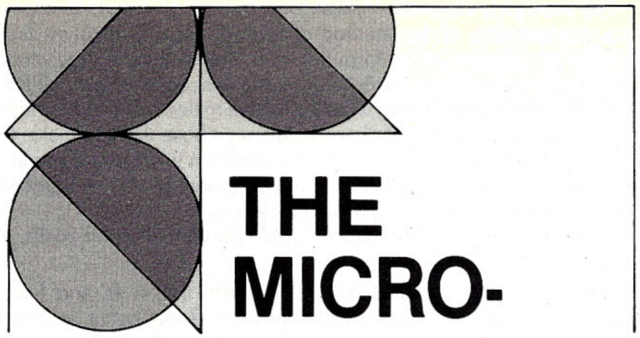
Lines 6000 through 6120 are a simple joystick routine. It waits until the player pushes the stick up, down, left or right. It returns the value 1 for up, 2 for left, 3 for right, and 4 for down.

Now it's time to go have some fun. Let me know how you've used the pieces of this game in writing your own. If I like it, I might even share it with the other readers of this column.☐

Al Baker can be contacted at The Image Producers, Inc., 615 Academy Drive, Northbrook, IL 60062.

```
10 REM ..PLAY AFTER ME
20 REM
30 REM .RESERVE ROOM FOR THE TUNE
40 DIM TUNE(100)
50 REM
60 REM DEFINE THE FOUR NOTES
70 DIM KNOTE(4)
80 KNOTE(1)=121:REM MIDDLE C
90 KNOTE(2)=96:REM .E ABOVE MIDDLE C
100 KNOTE(3)=81:REM .G ABOVE MIDDLE C
110 KNOTE(4)=60:REM .C ABOVE MIDDLE C
120 REM
130 REM DEFINE THE FOUR COLORS
140 DIM CVALUE(4),CBRIGHT(4)
150 CVALUE(1)=2:REM .RICH GOLD
160 CBRIGHT(1)=6
170 CVALUE(2)=14:REM .RED
180 CBRIGHT(2)=4
190 CVALUE(3)=6:REM .BLUE
200 CBRIGHT(3)=6
```

```
210 CVALUE(4)=10:REM .GREEN
220 CBRIGHT(4)=6
230 REM
240 REM GO TO FULL SCREEN LARGE
250 REM LETTERS AND SET ALL COLOR
260 REM REGISTERS TO BLACK
270 GRAPHICS 18
280 SETCOLOR 0,0,0
290 SETCOLOR 1,0,0
300 SETCOLOR 2,0,0
310 SETCOLOR 3,0,0
320 REM
330 REM PLACE THE FOUR COLOR WORDS
340 REM ON THE SCREEN IN BLACK
350 POSITION 7,2
360 PRINT #6;"YELLOW"
370 POSITION 2,5
380 PRINT #6;"red":REM .LOWER CASE
390 POSITION 14,5
400 PRINT #6;"BLUE":REM .REVERSE VIDEO
410 POSITION 7,8
420 PRINT #6;"green":REM .L.C. AND R.V
430 REM
440 REM INITIALIZE COUNTER
450 CNT=0
460 REM
470 REM ADD A NOTE TO COMPUTER TUNE
480 CNT=CNT+1
490 TUNE(CNT)=INT(RND(1)*4)+1
500 REM
510 REM PLAY THE TUNE
520 FOR I=1 TO CNT
530 PLAY=TUNE(I)
540 GOSUB 2000
560 NEXT I
570 REM
580 REM PREPARE FOR PLAYER'S TRY
590 I=0
600 I=I+1
610 IF I<=CNT THEN 635
620 REM
622 REM PLAYER IS CORRECT
624 SETCOLOR 4,0,14
625 FOR J=0 TO 200
626 NEXT J
628 SETCOLOR 4,0,0
629 GOTO 480
630 REM
632 REM GET PLAYER'S NEXT NOTE
635 GOSUB 6000
640 GOSUB 2000
650 IF PLAY=TUNE(I) THEN 600
660 REM
670 REM PLAYER IS WRONG
680 SOUND 0,200,10,8
690 FOR J=0 TO 128
700 SETCOLOR 4,0,J
710 NEXT J
720 SOUND 0,0,0,0
730 GRAPHICS 0
740 PRINT "YOU GOT UP TO ";CNT-1;
750 PRINT " NOTES."
760 END
1960 REM
1970 REM PLAY THE MUSICAL NOTE
1980 REM (LIKE AN ORGAN, PLEASE)
1990 REM AND TURN ON THE COLOR
2000 SOUND 0,KNOTE(PLAY),10,8
2020 SOUND 1,KNOTE(PLAY)/1.26,10,8
2030 SOUND 2,KNOTE(PLAY)/1.5,10,8
2040 SETCOLOR PLAY-1,CVALUE(PLAY),CBRIGH
T(PLAY)
3000 FOR J=0 TO 100
3010 NEXT J
4010 SOUND 0,0,0,0
4020 SOUND 1,0,0,0
4030 SOUND 2,0,0,0
4040 SETCOLOR PLAY-1,0,0
4100 RETURN
5970 REM
5980 REM GET PLAYER JOYSTICK
5990 REM INPUT
6000 PLAY=0
6040 WHAT=STICK(0)
6050 IF WHAT=14 THEN PLAY=1
6060 IF WHAT=11 THEN PLAY=2
6070 IF WHAT=7 THEN PLAY=3
6080 IF WHAT=13 THEN PLAY=4
6090 IF PLAY=0 THEN 6040
6120 RETURN
```



THE MICRO-MATHEMATICIAN

By Dr. Alfred Adler

SOLUTIONS OF TRANSCENDENTAL EQUATIONS

We are happy to announce that the long awaited day has finally arrived: our North Star DD MDS is finally alive and well. For those of you who do not yet have a disk system, let me point out that the step from cassette to disk is comparable to the step between bicycle and automobile. SAVEing, LOADing, making backups, relocating, and other manipulations are a real drag using an audio tape deck, but become a simple matter of a few keyboard operations with a disk system.

Naturally, all listings starting with this month's column will be presented in North Star BASIC (release 5). This is generally similar to PolyMorphic BASIC, the glaring difference being in the IF statements on a multistatement program line. In Poly BASIC, if the IF condition is false, all following statements on the same line are ignored. In North Star BASIC on the other hand, statements following the IF on the same line are unrelated to the IF and will be executed regardless of the outcome of the IF condition. Thus, (referring to the North Star Manual), the program

```
10 A=0
20 B=0
30 IF A<>0 THEN A=7 \ B=7
40 PRINT B
```

will yield 7 in North Star BASIC, but will yield 0 in Poly BASIC.

Now on to transcendental equations. A transcendental equation is defined as an equation that is not reducible to an algebraic equation. Now that is not what we would consider a useful definition. A more useful way to look at it might be to say that it is an equation with one unknown that cannot be written in explicit form. For example,

SIN(X) — X/4 = 0
and LOG(X) + X = 0 are transcendental equations.

Generally speaking, there are two ways to solve such equations: graphically, and iteratively (which means repeated trial and error).

To solve the first of the above equations graphically, consider Figure 1. Since the equation states that SIN(X) = X/4, we simply plot SIN(X) and plot X/4. The intersection (or intersections) of the two curves gives the solution (or solutions). This method presents no great difficulties unless there are many terms. It does, however, leave something to be desired in the way of accuracy.

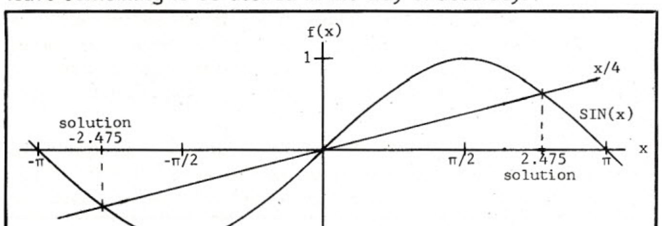


Figure 1.

Since in our work we rarely need iterative methods, and since each need is likely to be radically different from the one before, it makes little sense to maintain an elaborate array of iterative programs. We find it simplest to make a small sketch of the problem and then tailor a simple, possibly very crude program to obtain a solution. Since even a small microcomputer is so tremendously powerful compared to the needs of the iterative process, far more time is wasted in preparing an elegant routine than the extra few seconds required for even a ridiculously crude method.

The absolutely simplest, crudest, favorite method of ours is actually a degeneration of the method of false position. It involves first writing the equation in the form f(x) = 0; then estimating (by whatever means possible) a rough value of the desired root, and (VERY IMPORTANT) determining whether the estimated value is too high or too low. Armed with this knowledge, we chose the value of x at which we start our guessing game, the direction in which we modify our guesses, the step size between guesses, and a value of x before which it is safe to assume f(x) will cross zero.

To attempt to clarify the above jumble of words (read it again, it might help) refer to Figure 2.

We have written our equation in the form f(x) = 0, and have roughly sketched the shape of f(x) versus x. Roots occur at those points where the curve crosses the horizontal axis. From the sketch, it is apparent that a positive root occurs at $1<x<2$. We can start the iteration at x=1, incrementing x by .1 after each iteration, and we can be assured that before x=2, f(x) will have reversed its sign.

We watch the sign of f(x) carefully and as soon as it changes, we reverse the direction of our iteration, cut the step size down, and change the boundaries between which we are iterating. In other words, we start knowing we are too low, we move up by x=.1 increments until f(x) crosses zero (now we are too high), we reverse direction and cut down the interval.

When f(x) crosses zero again we are now too low, but presumably much closer to zero since we have been taking smaller steps. Again we reverse the direction of our x increments and again reduce the step size. If this is repeated enough times we can bring f(x) arbitrarily close to zero. We watch the size of f(x) and when it becomes sufficiently small, we terminate the iteration.

As an example, let us find the root of

f(x) = EXP(x) + COS(x) — x^2 = 0

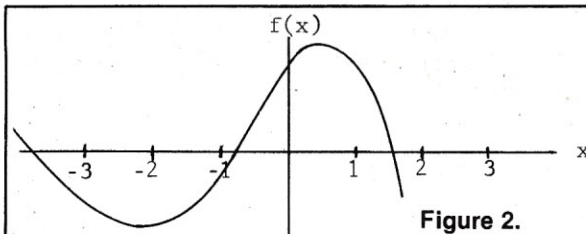


Figure 2.

In Figure 3 the three component parts of f(x) have been plotted. Note that for values of x less than about $-\pi$, f(x) is clearly negative, and for values of x greater than 0, f(x) is clearly positive. We will therefore iterate from x=—3.2 to x=0 with a step size of .1.

When f(x) crosses from negative to positive we will start the new iteration at the current value of x, let the new limiting value for x be the former beginning value, and change the step size to $-\frac{1}{10}$ of the former step size, thus reversing the direction of iteration. Program ITERATE, which follows, illustrates the procedure.

Statement number 130 steps up the initial iteration, starting at A, ending at B, with step size S. F is a counter that keeps track of the direction in which Z (f(x)) is going. It directs a continuation of the loop if $Z<0$ or if $Z>0$, depending on whether it is odd or even (see statement numbers 200, 210 and 240).

When Z crosses zero, the direction of iteration is reversed, the interval is reduced, the limiting values (A and B) are altered, and F is updated (see statement numbers 230 and 260). The printout shows all the values of Z, the current value of F, and indicates whether the program is still in the loop (!NEXT), or has reached statement numbers 230 or 260.

All this extra garbage was printed out as an aid to program development and it seemed like a good idea to leave it in for publication. We recommend the reader delete 99% of it in his printout.

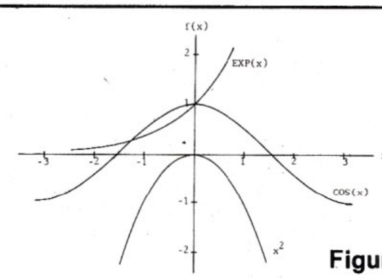


Figure 3.

In the event that f(x) is a differentiable function, a very simple but far more sophisticated method is available. This is the well known Newton-Raphson method. Referring to Figure 4, let x_1 be the first rough guess at the root. A tangent to f(x) at x_1 intersects the horizontal axis at x_2 and makes an angle A with the horizontal axis. From the figure it is apparent that

$$\tan A = f'(x_1) = \frac{f(x_1)}{x_1 - x_2}$$

where $f'(x)$ is the first derivative of f(x) with respect to x, and $f(x_1)$ is f(x) evaluated at x_1. Solving for x_2 we obtain

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)}$$

and in general

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

Using the same f(x) as before, namely

$$f(x) = EXP(x) + COS(x) - x\text{^}2 = 0$$

we find by differentiation that

$$f'(x) = EXP(x) - SIN(x) - 2*x$$

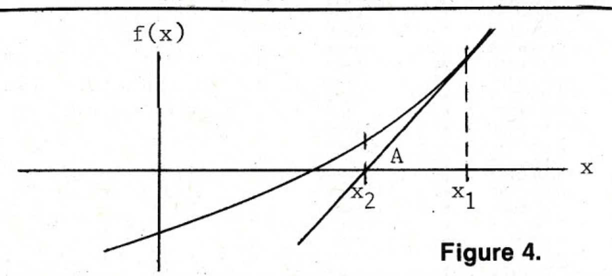


Figure 4.

Program NEWTRAPH, presented below, illustrates this method. Two runs are shown, one starting at x = —2 (see statement number 150) and the other starting at x = —10. Note the extremely rapid convergence. One caveat, however; if more than one root exists, the method will generally (but not always) converge on the nearest root. Under certain circumstances considerable difficulty *might* be encountered in making the routine converge on the desired root.□

Contact Dr. Adler at 10360 Flintlock Trail, Tucson, AZ 85715.

PROGRAM LISTING 1

```
10 REMIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
15 REM
20 REMIIIIIIIII   P r o g r a m    I T E R A T E   III
30 REM
40 REMIIIIIIIIIIII   Version 1.0   IIII   July 1979   IIIIIII
50 REM
60 REMIIIIIIIII   Written by - Alfred A. Adler Ph.D.   IIII
70 REM
80 REM This program is an example of a typical iteration routine.
90 REM It is conceptually very simple, and represents a crude,
100 REM brute force technique. It has the advantage of having few
110 REM pitfalls for the unwary and almost always works.
120 !
130 F=1\A=-3.2\B=0\S=.1
140 !TAB(6),"Z",TAB(16),"F",TAB(25),"LOOP"\!
150 FOR X=A TO B STEP S
160 Z=EXP(X)+COS(X)-X^2
170 !%12F8,Z,
180 IF ABS(Z)<=.00000001 THEN 290
190 !TAB(15),F,
200 IF F/2=INT(F/2) THEN 240
210 IF Z<0 THEN 270
220 !TAB(25),"230"
230 B=A\A=X\S=-S/10\F=F+1\EXIT 150
240 IF Z>0 THEN 270
250 !TAB(25),"260"
260 B=A\A=X\S=-S/10\F=F+1\EXIT 150
270 !TAB(25),"NEXT"\NEXT
280 !F,S,
290 !TAB(25),"X = ",X
READY
RUN
     Z            F         LOOP

-11.19753200      1         NEXT
-10.56408600      1         NEXT
 -9.94020540      1         NEXT
 -9.32593500      1         NEXT
 -8.72141230      1         NEXT
 -8.12686670      1         NEXT
 -7.54261520      1         NEXT
 -6.96905860      1         NEXT
 -6.40667580      1         NEXT
 -5.85601720      1         NEXT
 -5.31769800      1         NEXT
 -4.79238970      1         NEXT
 -4.28081160      1         NEXT
 -3.78372100      1         NEXT
 -3.30190320      1         NEXT
 -2.83616100      1         NEXT
```

```
   -2.38730300    1          NEXT
   -1.95613270    1          NEXT
   -1.54343590    1          NEXT
   -1.14996940    1          NEXT
    -.77644800    1          NEXT
    -.42353280    1          NEXT
    -.09181830    1          NEXT
     .21817960    1          230
     .21817960    2          NEXT
     .18817000    2          NEXT
     .15793920    2          NEXT
     .12748768    2          NEXT
     .09681586    2          NEXT
     .06592410    2          NEXT
     .03481286    2          NEXT
     .00348255    2          NEXT
    -.02806637    2          260
    -.02806637    3          NEXT
    -.02490162    3          NEXT
    -.02173910    3          NEXT
    -.01857875    3          NEXT
    -.01542058    3          NEXT
    -.01226458    3          NEXT
    -.00911078    3          NEXT
    -.00595918    3          NEXT
    -.00280975    3          NEXT
     .00033752    3          230
     .00033752    4          NEXT
     .00002287    4          NEXT
    -.00029177    4          260
    -.00029177    5          NEXT
    -.00026030    5          NEXT
    -.00022884    5          NEXT
    -.00019738    5          NEXT
    -.00016590    5          NEXT
    -.00013446    5          NEXT
    -.00010299    5          NEXT
    -.00007152    5          NEXT
    -.00004004    5          NEXT
    -.00000860    5          NEXT
     .00002287    5          230
     .00002287    6          NEXT
     .00001972    6          NEXT
     .00001658    6          NEXT
     .00001342    6          NEXT
     .00001028    6          NEXT
     .00000713    6          NEXT
     .00000398    6          NEXT
     .00000084    6          NEXT
    -.00000231    6          260
    -.00000231    7          NEXT
    -.00000196    7          NEXT
    -.00000166    7          NEXT
    -.00000135    7          NEXT
    -.00000105    7          NEXT
    -.00000073    7          NEXT
    -.00000039    7          NEXT
    -.00000009    7          NEXT
     .00000022    7          230
     .00000022    8          NEXT
     .00000020    8          NEXT
     .00000018    8          NEXT
     .00000016    8          NEXT
     .00000014    8          NEXT
     .00000001               X =  -.97110725
READY
BYE
+
```

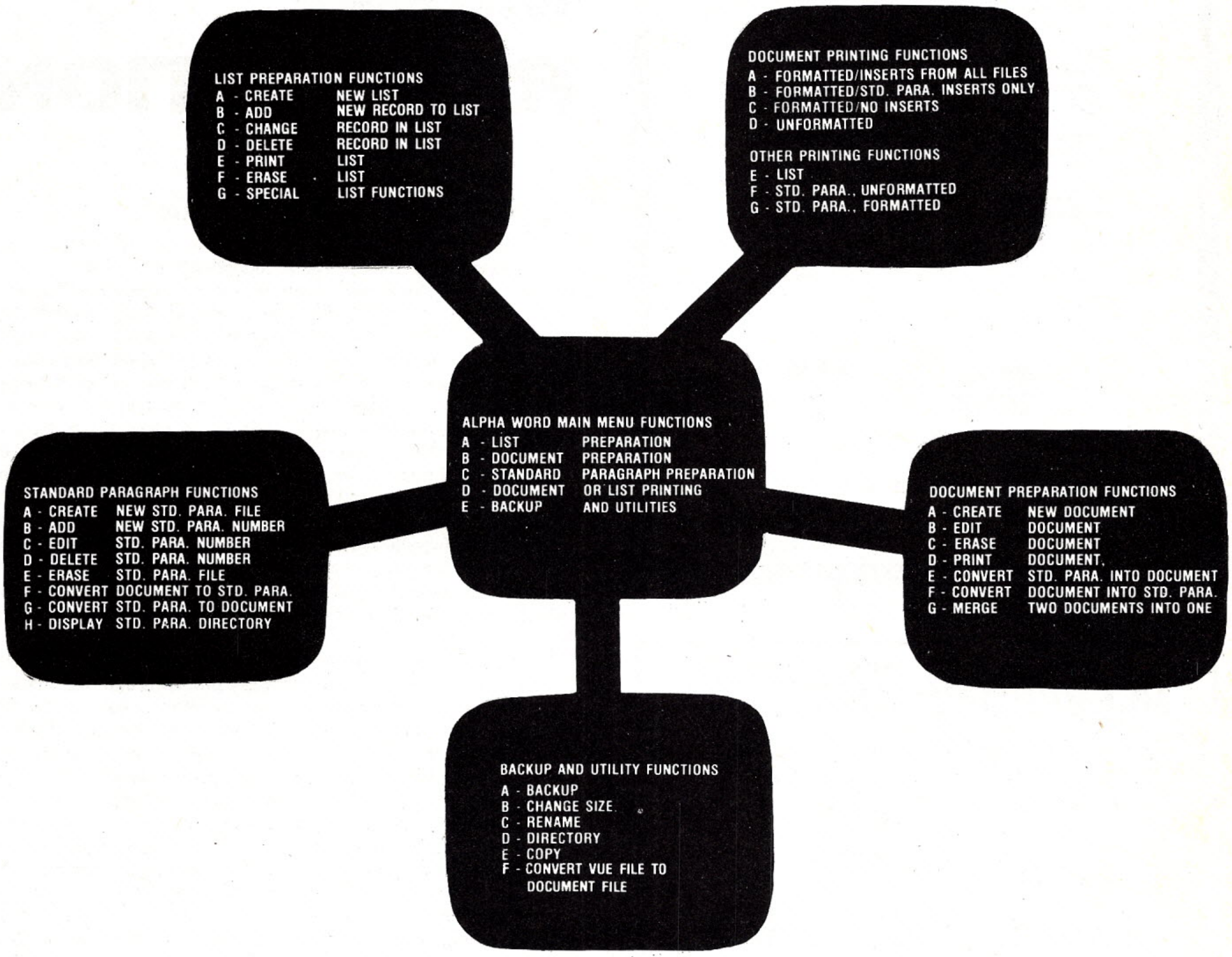
PROGRAM LISTING 2

```
10 REMXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
20 REM
30 REMXXXXX    P r o g r a m    N E W T R A P H    XXX
40 REM
50 REMXXXXXXXXXX   Version 1.0   xxxxxxx   July 1979   XXXXXXXX
60 REM
70 REMXXXXXXXXX   Written by   Alfred A. Adler   Ph.D.   XXXXXXX
80 REM
90 REM This program illustrates the use of the Newton-Raphson method
100 REM for finding a root of an equation of the form f(x) = 0,
110 REM where f(x) is a differentiable function.
120 REM Note that this method, although quite simple, is considerbly
130 REM more sophisticated than a brute force iteration. It contains
140 REM a few more pitfalls but converges very much faster.
150 X=-2
160 N=0
170 !TAB(6),"T",TAB(16),"N"
175 !
180 Z  = EXP(X)+COS(X)-X^2
190 Z1 = EXP(X)-SIN(X)-2*X
200 T=X-Z/Z1
210 !%12F8,T,\!TAB(15),N
220 IF ABS(T-X) <=.00000001 THEN 260
230 X=T
240 N=N+1
250 GOTO 180
260 !"X = ",T
READY
RUN

      T          N
 -1.15141260     0
  -.98088510     1
  -.97114021     2
  -.97110727     3
  -.97110726     4
X =  -.97110726
READY
150 X=-10
RUN
      T          N
 -4.81707900     0
 -2.14682000     1
 -1.18729450     2
  -.98478450     3
  -.97117152     4
  -.97110728     5
  -.97110726     6
  -.97110726     7
X =  -.97110726
READY
```

ALPHA WORD™

ALPHA MICRO MENU DRIVEN WORD PROCESSOR



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The Document and Standard Paragraph processors have the main features of Alpha Micro's VUE text processor, including line insert and delete, word insert and delete, page skipping, global search and replace, automatic linefeed at the end of the line, and block move, copy and delete. Your text is interactively stored on disk to ensure system reliability.

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The users manual for ALPHA WORD is written in such a manner that your secretary can easily learn the system in a few hours. This is possible through the use of extensive examples and an easy to read style.

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Basic callable assembly language routines included with each ALPHA WORD order (demo or full system) include routines to perform the following functions; 1) Upper case, 2) Sleep terminal, 3) Free disk blocks, 4) Current unit number, 5) Generalized line input routine, 6) Basic file renumbering (includes GO TO #, IF/THEN #, and GOSUB # renumbering), and 7) Terminal driver for Soroc IQ 140 translating user define keys to ALPHA WORD or VUE control codes.

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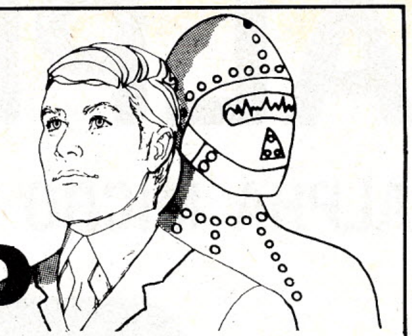
THE MIND REVOLUTION



By Merl Miller with Ed Uecker

Can computers think? We've addressed this problem on a number of occasions and the answer always seems to be an emphatic "Maybe!" At the center of the controversy is a fundamental question, "What is intelligent thought?" Computers can be programmed to *simulate* thought and response but are they *actually thinking*? A great number of computers have been programmed to solve problems in a given area through a trial-and-error program with which the machine simply responds to random variables. In order to actually say that a computer can think, it would be necessary for the computer to have the ability to communicate by both initiating and responding to communication.

So, the first consideration is language which, in the case of the computer, is binary arithmetic. Instruction and execution operate on the simple on/off mode of the computer circuits. This *machine language* is the method of symbol and pattern recognition which permits the machine to "think" — that is, to make computations and solve problems.

If we use a compiler we can broaden the machine's capabilities to handle a wider variety of more complex problems and responses. It is, essentially, very much the same way we teach a baby to talk. We take the "unit," supply it with a language and, by expanding the language and developing the ability to conceptualize, we give the baby the ability to solve even more complex problems.

The two paths of teaching a computer and teaching a baby divide at the point where the young child begins to process new information, at random, from out of the environment. This appears to be the critical factor in teaching a computer to "think" or "reason." We can teach both baby and computer a language or symbol system, but beyond that point factors of environment, self-preservation, morality and hundreds of other "human values" may enter into the process — factors which would not affect or enhance the computer's ability to compute and respond.

The classic example of how a computer can be taught to simulate language and intelligent thought is Professor Joseph Weizenbaum's MIT Project, "Eliza." Eliza has been programmed to simulate the responses of a psychiatrist within certain parameters; a typical run might look like this:

PLEASE TELL ME YOUR PROBLEM
I'm feeling depressed

HOW LONG HAVE YOU BEEN FEELING DEPRESSED?
Ever since my mother left me

TELL ME MORE ABOUT YOUR FAMILY
My father is very strict

PLEASE GO ON
Last night I dreamed he spanked me

WHAT WOULD IT MEAN TO YOU IF HE SPANKED YOU?
Didn't you ever get spanked?

WE WERE DISCUSSING YOU, NOT ME
You're just a dumb machine, anyway

DO COMPUTERS FRIGHTEN YOU?

Now, a number of people might say, "Aha, that computer is thinking. . .see how it responds!?!" But, alas, it is not thinking at all. What seems like an actual exchange between psychiatrist and patient is not. Eliza has been programmed, using a simple system of patterns that contain key words to which she responds in certain ways — much like we would train a dog. Whenever Eliza hears, "I am. . .", she responds, "How long have you been. . .?" and fills in the end of her question with the end of the patient's original statement.

Professor Weizenbaum has programmed Eliza to respond to a great number of questions with particular answers. With the addition of a voice simulator and lifelike, "Disneyland"-type mannequin, Eliza could easily simulate a psychiatrist. But, we still encounter the same basic problem we had in comparing computers and babies — the inability to conceptualize and respond to anything outside of a finite pattern of variables. The following exchange would be every bit as likely as the first:

PLEASE TELL ME YOUR PROBLEM
I am green

HOW LONG HAVE YOU BEEN GREEN?
My mother

TELL ME MORE ABOUT YOUR FAMILY
Everyone eats worms

WHO, IN PARTICULAR, CAN YOU THINK OF?
You

WE WERE DISCUSSING YOU, NOT ME
Peanut butter is good for your ears

PLEASE GO ON
You stupid machine!

DO COMPUTERS FRIGHTEN YOU?

Because the programmed information is fragmented, Eliza does not really "understand" what is going on here. She merely responds in a predetermined manner to the key words. If Eliza does not hear a key word in a statement, she simply responds, "Please go on." So, Eliza may reply "Please go on" to a perfectly reasonable, or important, question or statement and respond, "Who, in particular, can you think of?" upon hearing the key word "everyone" in the sentence, "Everyone eats worms." In short, Eliza cannot tell the difference between rational response and total gibberish. She is like a baby who has acquired certain words and can respond to certain symbols or situations, but cannot respond intelligently to anything outside her sphere of experience or programming.

Professor Weizenbaum designed Eliza to point out how little a machine needs to know to appear competent. But the programming also points out the fact that the machine only *responds.* It does not *think,* nor *understand* what you are saying. A computer simply responds to the numerous variables found in humans as a race but, especially, *not* to the even more numerous individual quirks of opinion, personality, ignorance, insanity, etc.

Because we do not yet understand exactly what the physical mechanisms are behind the human ability to think and reason, we are still at an impasse with the question we led off with, "Can computers think?" Since we don't yet understand how man thinks, and since computers are an extension of man's understanding of his own abilities (highly refined in terms of order and speed), we must assume that when man discovers how it is that he thinks, he may discover a way to program computers to think and react intelligently.

Man, in many ways, is the intellectual inferior of the computer. The machine is certainly better organized and the computer's memory is almost infinitely expandable. It is without a doubt, though, that before we can learn to program a computer to make the kind of self-initiated changes that take place in man and allow him to sharpen his intellect and judgement, we will have to discover the "nature" of the mechanisms that allow these developments to occur in man.□

If you have any opinions, ideas or suggestions relating to the theme of this column, contact Merl Miller at 30 N.W. 23rd Place, Portland, OR 97210.

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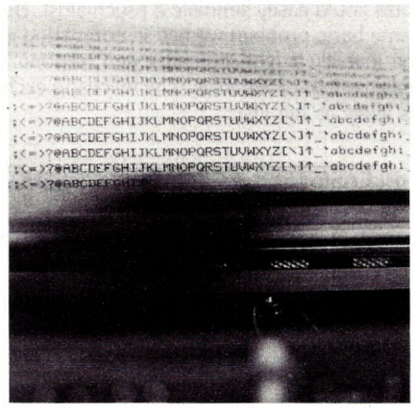

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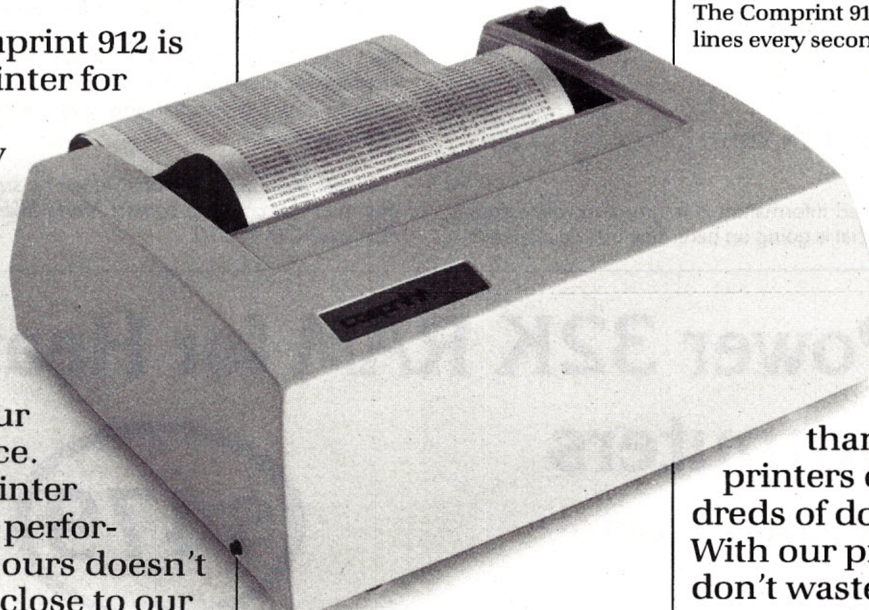

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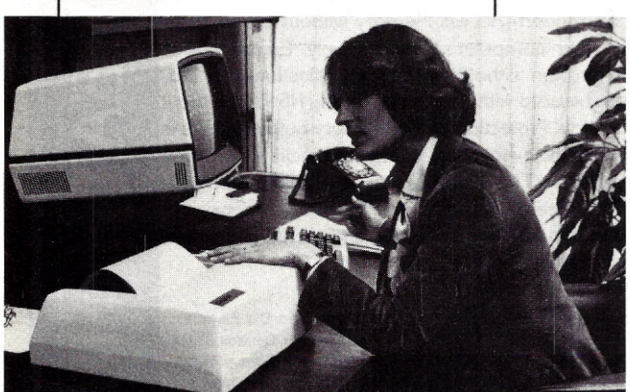

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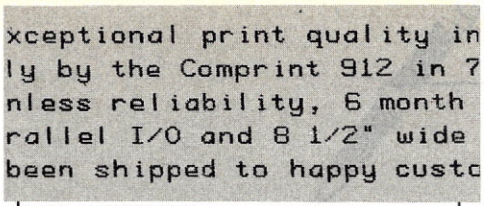

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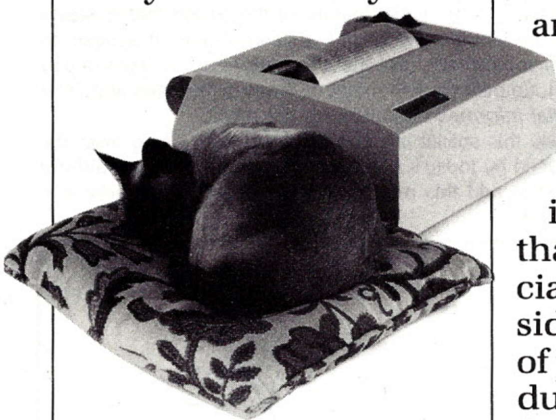

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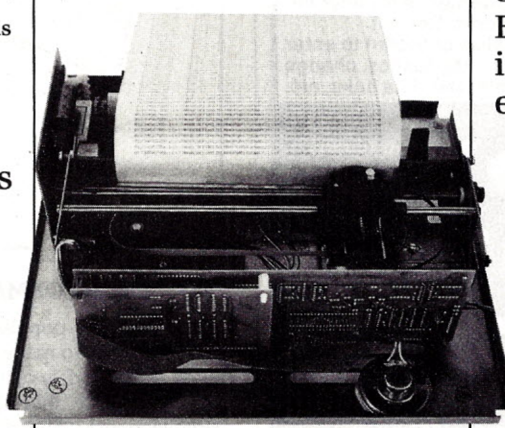

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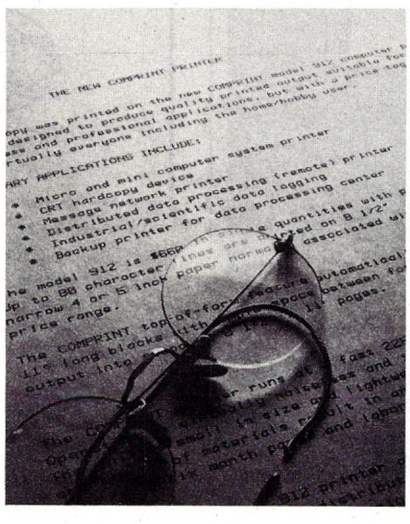

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THE INVENTOR'S SKETCHPAD

By Roger Garrett
Contributing Editor

SPATIAL INFORMATION IN AUDIO OUTPUT

Many of the popular personal computers now come equipped with the ability to make sounds. Some can just beep; others can produce a wide variety of individual tones; and others can even produce four-part music, that is, four different tones with unique waveforms simultaneously. There is a system that allows you to record music or speech on its cassette and play it back over a speaker under program control. The Texas Instruments microcomputer even has a voice output option based on their Speak-and-Spell device.

Each of these devices adds a unique dimension of information output. Yet there is an aspect to these sounds which all of the manufacturers seem to have overlooked which can add an important element of realism to the sounds. When you place a high fidelity stereo record on your home stereo system, turn it on, and then sit back to enjoy the music, a very crucial feature of the sound that makes it sound real is the fact that the sound is stereophonic; it appears to originate from somewhere "out there" in the room, in front of you or behind you, up over your shoulder or down in the basement. You perceive *spatial information* along with the music.

It is precisely this spatial information which is missing from the sounds produced by today's personal computers. Yet it should not be too difficult to add this missing element. I will show here one possible method.

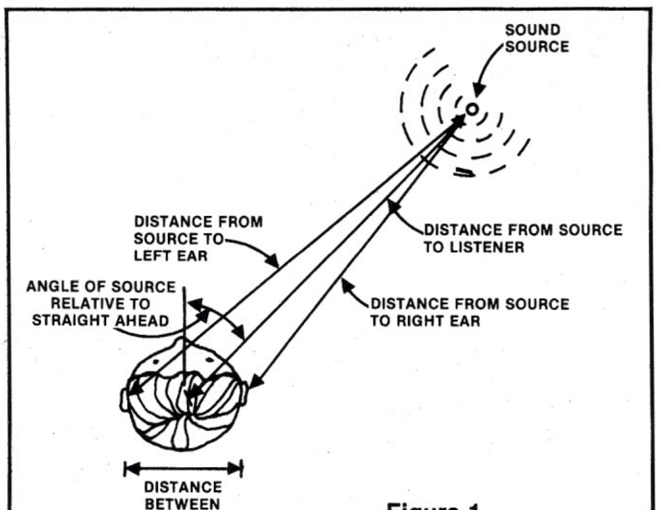
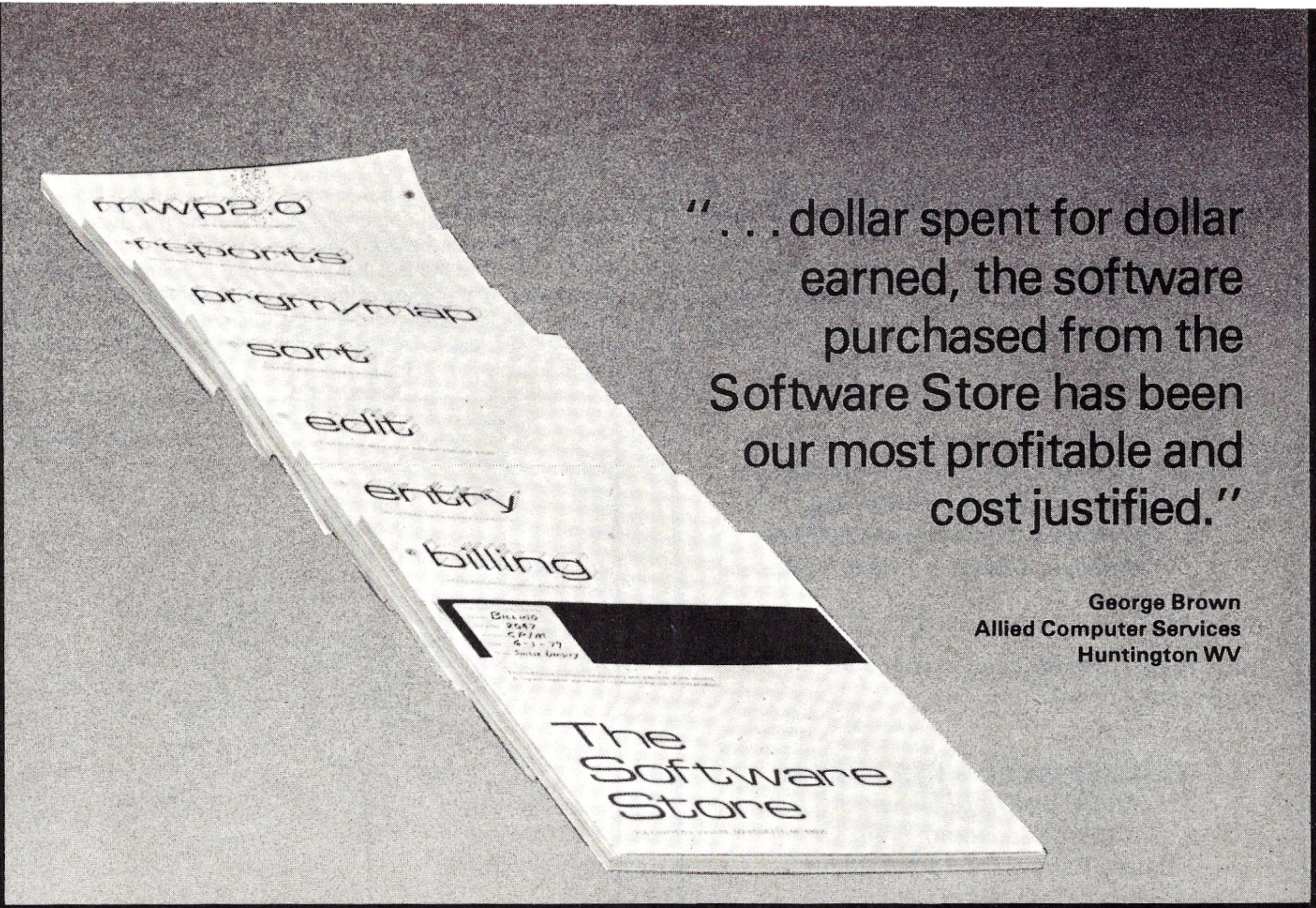


Figure 1.

First we need to understand how we perceive the distance and direction of a sound source. Here is an overhead view of a sound source (perhaps a bee buzzing by) and a listener. The bee is a given distance from the listener and the line connecting the bee to the center of the listener's head makes an angle with the straight-ahead line through the listener's head.

The listener can perceive this distance and angle because the sound information received by his two ears are slightly different. The sound at the right ear will be slightly louder, so the brain perceives both a general sound intensity and a sound intensity differential between the two ears.



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The *system utilities* include programming tools such as the Program Map BASIC cross reference program along with general utilities such as the Disk Fix file recovery program, the Disk Copy (1D & 2D) diskette copy program, the TX-RX file transfer and media conversion programs and the CATALOG diskette library index program.

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CIRCLE INQUIRY NO. 72

Since sound is actually a stream of waves propagated through the air at a known speed (approximately 331 meters [1087 feet] per second) we can see that a given sound will arrive at the right ear a short time before it gets to the left ear. The brain perceives this *phase differential* and determines the direction and distance to the sound source.

Now let's assume we have a sound source of known intensity at a known distance and angle relative to the listener. Since we also know the distance between the ears of the listener, the speed of sound in air, and the fact that the intensity of sound decreases proportionately to the square of the distance between the source and the receiver, we can easily calculate the intensity of the sound that will arrive at each ear as well as the difference in time that it takes the sound to arrive at each ear.

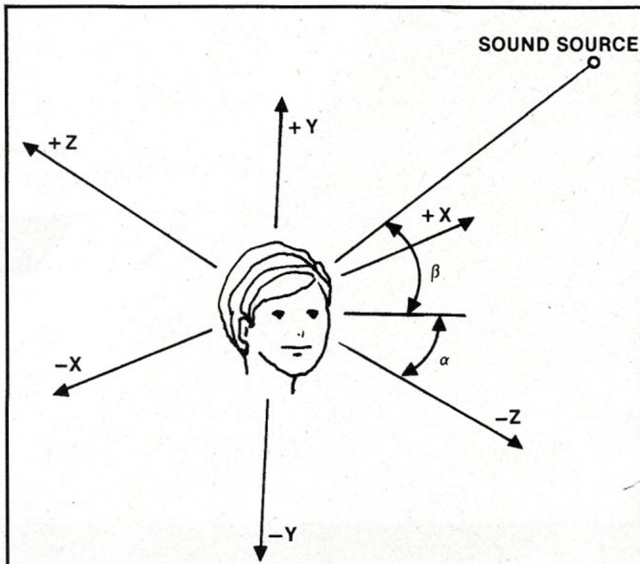

Figure 2.

Since the world is not two-dimensional as implied in the preceding figure, we really need one more piece of information to specify the position of a sound source. We can do this by adding one more angle to our calculations.

The position of the source is then defined by two angles, one measured from the positive Z axis towards the positive X axis and the other measured from the XZ plane towards the positive Y axis, and a distance. The results of the calculations are the same as for the two dimensional world, i.e. the sound intensity at each ear, the phase difference (expressed in seconds) and an indicator of which ear receives the signal first.

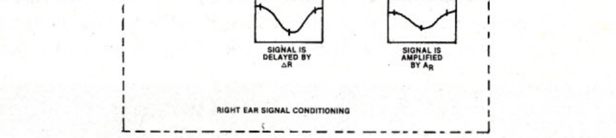

Figure 3.

All we need to do now is show how all this can be done by computer so that the computer can add spatial information to any given sound so that the listener hears it coming from position in space.

Let's assume we are running an aircraft simulation in which we are engaged in a dogfight with another airplane and that we have a piece of hardware that produces an airplane sound. At any given

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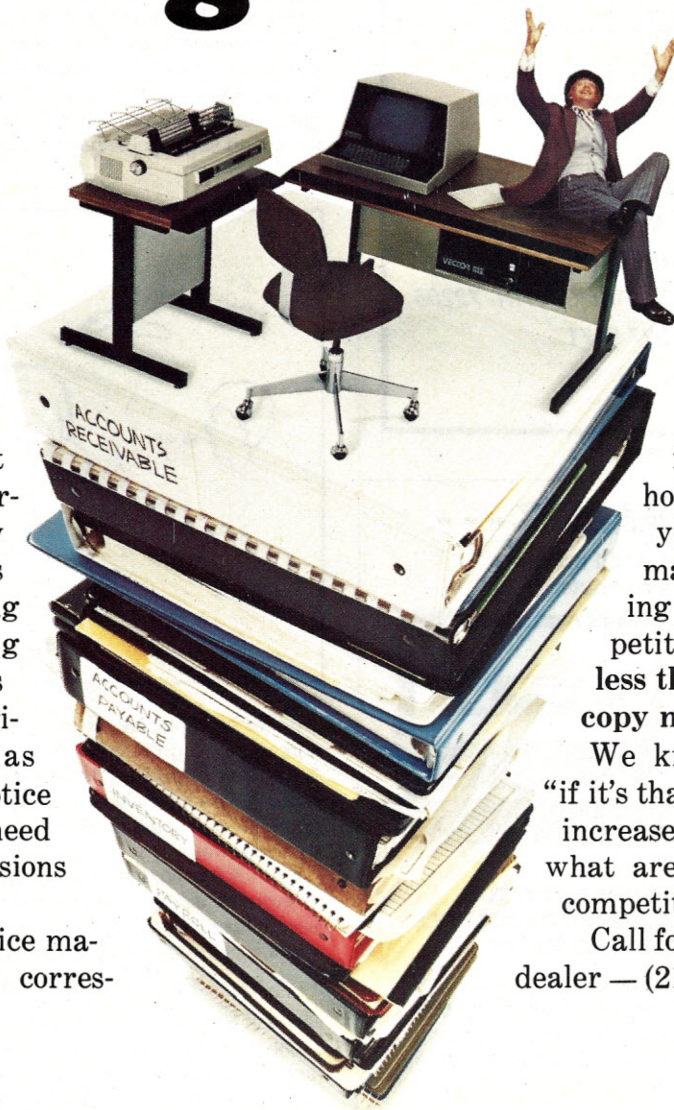

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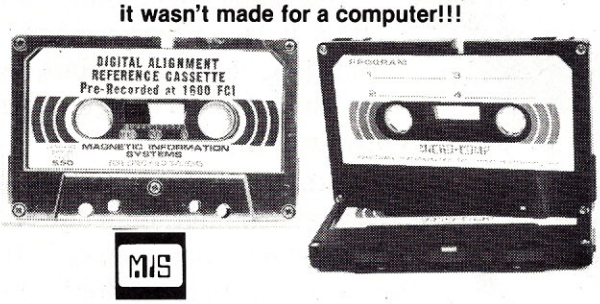


time during the simulation the computer knows the location of the enemy aircraft relative to your own position (we are assuming that you are flying the friendly craft via joystick controls). Furthermore, it knows the position relative to your head and can therefore calculate the intensity and phase differentials for your ears. The problem, then, reduces to appropriately modifying the sound of the enemy aircraft before it reaches your ears.

First we split the incoming signal (from the sound generator) into two identical signals; one will be headed for the left ear and the other for the right ear. Along each signal path we place an electronic delay line such as Radio Shack's dual analog delay IC (#276-1761). This device is used to delay the signal passing through it.

The speed with which the signal passes through is based upon the speed of its "clock." The faster the clock, the quicker the signal passes through. The computer controls the phase differential; it controls which ear receives the sound first and the time difference between each ear.

The sound intensity difference is controlled by two computer controlled amplifiers which can simply be another set of digital-to-analog convertors. The resultant modified signals are fed to the left and right side of a stereo headset. What the listener hears, then, is the original sound with spatial information added to it so that the enemy aircraft actually sounds as though it is "out there" in the air. Since the computer continually controls the phase differentials and amplitudes as the sound source changes position, the listener can actually hear it "fly" past him.

Figure 4.

In this example, we have assumed that there was a piece of hardware generating the original aircraft sound. This system works just as well on computer-generated sounds and synthesized speech. The computer could make it sound like there is someone to the right talking to you, some music playing far off to your left, or a bug flying past your nose.

From the programming standpoint, it should be quite simple to control the sounds and spatial information. Assuming that the listener is in the center of a three dimensional coordinate system, he might specify voice output and its position with a statement such as:

SAY "HELLO" AT X,Y,Z WITH:AN:INTENSITY OF Q

where X,Y,Z would be the position of the "speaker" and Q would be the intensity with which the word "HELLO" was pronounced. The range of Q would be between 0 (no intensity) and 1 (loudest intensity). In BASIC it might take the form of a function such as

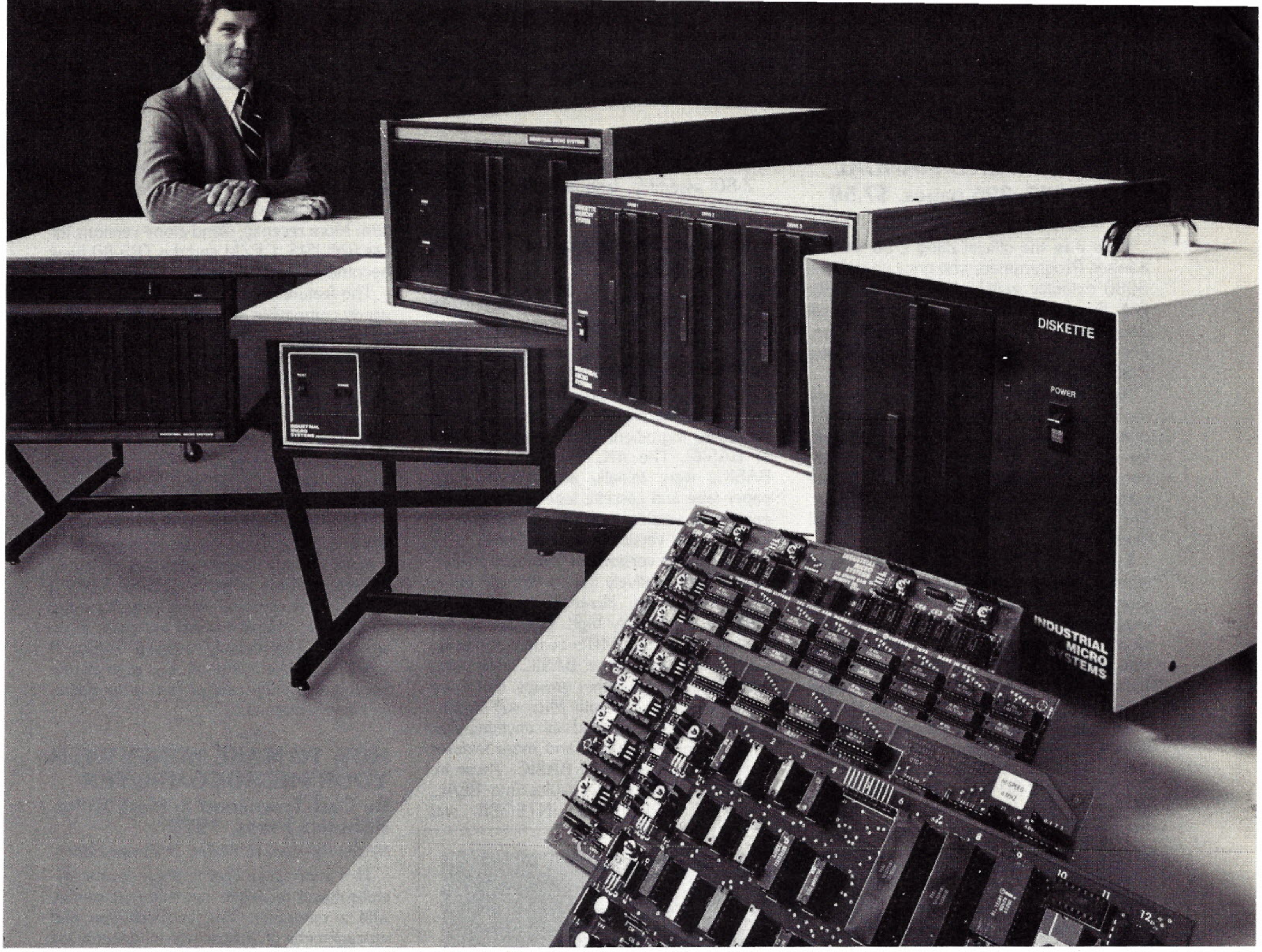
SAY (phonetic:string,X,Y,Z,Q)

If the sound source is not a voice output unit but rather a frequency generator or other such device then we might control the output with the following statement:

OUT (frequency, tone, X,Y,Z, intensity)

Such a device would certainly add a high degree of realism to any sound-generating program. Simulation as well as music-producing programs would certainly benefit from the spatial information system.□

Roger Garrett can be contacted at The Inventor's Sketchpad, 16 Grinnell Street, Jamestown, RI 02835.



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Z-80 ASSEMBLY LANGUAGE PROGRAMMING MANUAL

Zilog, 1977. 296 pages, $7.50

Review by Alan R. Miller, Software Editor

Here it is: the official Zilog Z-80 instruction set. Programmers who grew up with the 8080 naturally switched over to the Z-80. But they undoubtedly found the logical Zilog instruction mnemonics to be foreign. For example, the 8080 PCHL becomes the Z-80 JP (HL).

Xitan provided an easy method of weaning with a compromise Z-80 assembler. All of the equivalent 8080 mnemonics are used for the regular 8080 instructions. In addition, the 8080-like Z-80 instructions are coded to resemble the 8080 counterpart. For example, the stack pointer is loaded direct with LSPD.

Eventually, however, the day will come when a full conversion to the Zilog mnemonics will be desirable. The Microsoft macro assembler is a perfect choice for this, since either straight 8080 mnemonics or straight Z-80 mnemonics can be used. Unfortunately, a list of the Z-80 instruction mnemonics is not given in the user's manual.

The book begins with a 23-page review of assembly language programming. Most of the remainder of the book is devoted to the details of the Z-80 instruction set. Finally, the entire instruction set is summarized twice in the appendices, once alphabetically and once numerically.

Z-80 assembly language programmers will want to keep this manual handy.☐

MICROSOFT BASIC

By Ken Knecht

dilithium Press, 1979. 158 pages

Review by Alan R. Miller, Software Editor

The MITS Altair 8800 computer, with an 8080 CPU, started the revolution in microcomputing. But a computer isn't very useful without software. Microsoft provided this necessary ingredient with various versions of BASIC. The 4K, 8K, and Extended BASICs were initially available on both paper tape and cassette tape (the Extended paper-tape version took over a half hour to load). A disk version was added later.

The various versions of Microsoft BASIC were priced relatively low for the owners of MITS computers. However, the price to others was relatively high. Because of this pricing policy, non-MITS owners had to do without initially. In time, BASIC interpreters were developed by other groups. But those of us who grew up with Microsoft BASIC will never quite be satisfied with anything else.

Over the years, more and more features were added to Microsoft BASIC. These included the typing of variables into REAL, DOUBLE, PRECISION, INTEGER, and STRING, the addition of hexadecimal and octal constants, a renumber command and line printer output. The initial disk version was meant to be used as an operating system. More recently, stand-alone versions for use with ISIS, CP/M and the TRS-80 have become available.

The features of Microsoft BASIC are upwards compatible through the 4K, 8K, Extended, and Disk versions. Throughout Ken Knecht's book, the lowest level of BASIC for which a particular feature applies is identified. It appears that Version 4 of Microsoft's BASIC was used as the basis for the book.

A 100-page operator's manual accompanies Microsoft's BASIC. But while this manual is long on detail, it is short on illustrative examples. Ken Knecht's book fills this need by providing many useful examples.

A seven-page chapter addesses the peculiarities of Radio Shack's TRS-80 Level II BASIC. The reserved words (which cannot be used in variable names) are given in an appendix. The recently released Version 5 is not covered in the book. But all in all, the book makes a nice complement to the Microsoft user's manual.☐

HOW TO MAKE MONEY WITH YOUR MICROCOMPUTER

By Carl Townsend & Merl Miller

Robotics Press, 1979

Review by Alan R. Miller, Software Editor

This informative how-to book covers several subjects related to the making of money with a computer. The establishment and management of a business in general are discussed in two chapters. Then there are several chapters devoted to particular types of computer-related business. These include the opening of a computer store, and the operation of a business offering computer services.

Additional chapters cover techniques for selling one's own software and hardware, the operation of a computer show, and ideas for establishment of classes to teach computing techniques to others.

The chapters giving the details of technical writing are superb. Many of the ideas presented here are common to all types of writing, not just to computer-oriented text. Prospective authors wil find the detailed outline invaluable.

The appendices contain much useful information. There is a list of general reference works needed by anyone who writes articles in general. In addition, there are more specific reference books on computing and business. One appendix is devoted to grants and proposals. It details the writing of proposals and includes a list of publications specifically devoted to proposal preparation and submission.

One appendix gives the names and addresses of book publishers and another lists 41 computer magazines and their addresses. A sample contract for service is given in another appendix, but perhaps a lawyer should check this over.☐


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TRS-80 MICROCOMPUTER TECHNICAL REFERENCE HANDBOOK

Radio Shack, 1978. 108 pages

Review by Alan R. Miller, Software Editor

The purpose of this book (manual, actually) is to give the Radio Shack TRS-80 owner a practical knowledge of his computer's hardware. But unlike the usual microcomputer, the TRS-80 is a sealed package. It is not likely to be purchased by the kind of person who will want to add a new board now and then, change a jumper here or add another feature there.

Yet, here is a book "written for the technical person, by a technical person" (according to the preface). It is also suggested that the reader should know what HEX means, and be able to distinguish a NOR gate from a NAND gate.

Finally, the reader is warned that any work he performs on his TRS-80 "voids the warranty. . .So once you open the cabinet, you're on your own."

After an introduction like that, will anyone want to continue? The reader who does continue will find out many things about his computer. The book is written in an easy-reading style, very uncharacteristic of the usual manual.

A block diagram of the entire computer is presented, clearly showing the interrelationships of the CPU, RAM, ROM, keyboard, video, tape recorder, power supply and buses. The next section discusses the theory of operation for these blocks including the memory-mapped video.

The section on Adjustments and Troubleshooting contains 25 pages of instructions, repair flowcharts and data. A parts list and a set of schematics are included at the back. □

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1. TITLE OF PUBLICATION: INTERFACE AGE MAGAZINE — A. PUBLICATION NO. 0 1 4 7 2 9 9 2 — 2. DATE OF FILING: 9/29/79

3. FREQUENCY OF ISSUE: Monthly — A. NO. OF ISSUES PUBLISHED ANNUALLY: 12 — B. ANNUAL SUBSCRIPTION PRICE: $18.00

4. LOCATION OF KNOWN OFFICE OF PUBLICATION (Street, City, County, State and ZIP Code) (Not printers): 16704 Marquardt Ave., Cerritos, Ca. 90701

5. LOCATION OF THE HEADQUARTERS OR GENERAL BUSINESS OFFICES OF THE PUBLISHERS (Not printers): Same As Above

6. NAMES AND COMPLETE ADDRESSES OF PUBLISHER, EDITOR, AND MANAGING EDITOR

PUBLISHER (Name and Address): McPheters, Wolfe & Jones - 16704 Marquardt Ave., Cerritos, Ca. 90701

EDITOR (Name and Address): Carl Warren - same as above

MANAGING EDITOR (Name and Address): N/A

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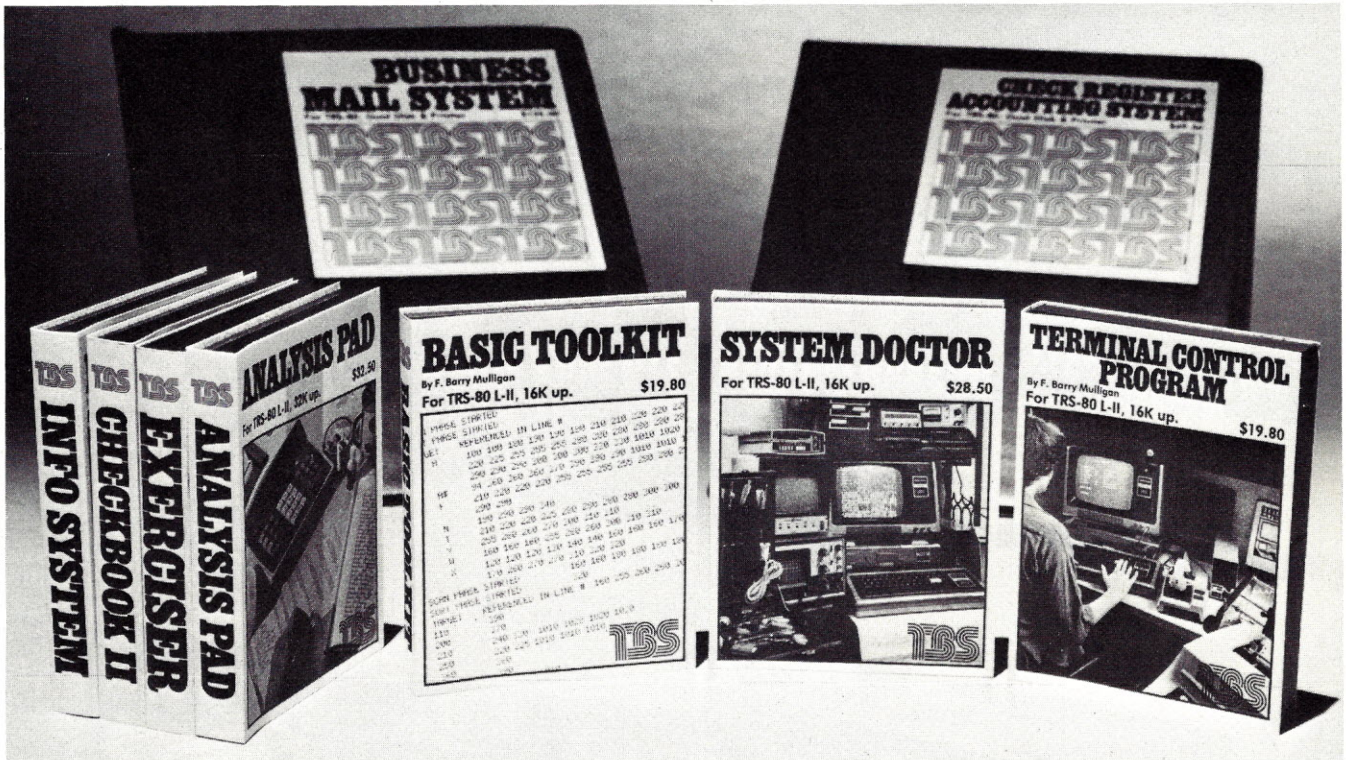

Use your TRS-80 Level II more effectively with these system utilities from **TBS**.

BASIC TOOLKIT by F. Barry Mulligan is a basic programmer's dream come true. This program has the following features. Variables Map - Gives an alphabetical listing of each variable used, a list of the lines the variables appear on, and shows the number of times the variable appears on the line. Goto X Ref - Lists in numerical sequence the destination of each GOTO and GOSUB statement and the line number that it appears on. Recall - Allows you to recall a program after you have hit reset, accidentally typed NEW or have booted back to DOS. Merge - Enables you to merge tape or disk programs. Test Memory - Does a thorough check of memory to be sure every location is operable. Search Memory - Search for every occurrence of a two-byte combination and list the location where it occurs. **BASIC TOOLKIT** is resident in memory while programming and is accessed by hitting shift/break. A must for basic programmers, this utility sells for $19.80.

SYSTEM DOCTOR does a thorough diagnostic check of your entire computer system. It lets you know if something is wrong before you spend time programming or entering data. The program checks the ROM to ensure that every bit is functional and checks the RAM six different ways. The disk drives are tested in a variety of ways to ensure reliability. The cassette recorder is also tested for speed, volume and distortion with the help of a calibration tape provided with the program. The video memory and display are also checked as well as the line printer. **SYSTEM DOCTOR** also does a 12-hour check of the entire system and records the results on tape, disk or the screen. As a bonus, this program also includes the **DISK DRIVE HEAD CLEANER**. The card insert that cleans the head can be obtained free by mailing in the coupon provided. For $28.50, **SYSTEM DOCTOR** is the first complete diagnostic program for the TRS-80.

TERMINAL CONTROL by F. Barry Mulligan is a machine language utility that enables you to use all the potentials of RS-232 tele-communications without hassel. It can interface to any Level II BASIC or assembly language program, or may be used as a stand-alone system to send and receive entire programs or data. The beauty of this program is that it turns your computer into a truly smart terminal. All RS-232 features can be set from the keyboard and the current values can be displayed or changed at any time. Basic programs can be sent in Level II compressed format for high-speed exchange. Whether you want to send or receive data from a basic program, save what comes down the line, converse with any other terminal or computer, exchange programs, or try any of the possibilities that computer communications has opened up, **TERMINAL CONTROL** is your answer. Only briefly described here, this remarkable program sells for only $19.80.

TBS has other great software for your TRS-80. **CHECKBOOK II, INFORMATION SYSTEM & EXERCISER** are general applications. **BUSINESS MAIL LIST, DATA BASE MANAGER, CHECK REGISTER ACCOUNTING SYSTEM & ANALYSIS PAD** are strong applications for business. Don't forget the **LIBRARY 100**; 100 programs for only $49.50. **TBS** also has **DISK HEAD CLEANERS** for **TRS-80** and **APPLE** and **GRAN MASTER DISKETTES**, the best on the market.

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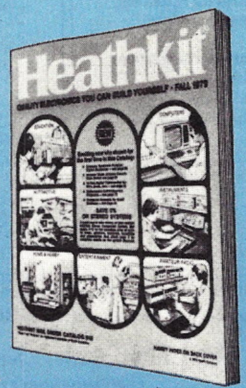

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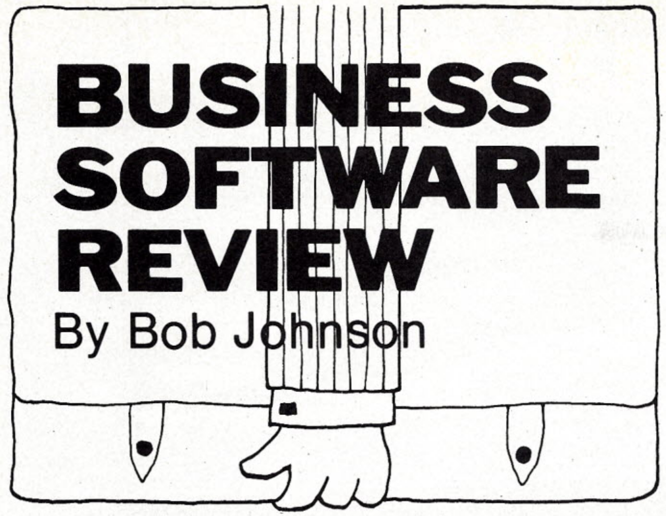


MASTER TAX PROGRAM FROM CPAids

CPAids was founded in October 1977, and one of the company's CPAs developed the tax packages evaluated this month for use in their own tax service. CPAids claims that an average return now takes less than thirty minutes to prepare, using their package. We tend to believe this, after reviewing the Master Tax Program.

The MTP is a complete tax preparation package for accountants, attorneys, and tax services who prepare more than 300 returns per year. It and other programs are currently available to run under North Star BASIC, CP/M and Microsoft BASIC, and soon to be available for CP/M and CBASIC-2.

Some of the advantages claimed by CPAids are: speedy, personalized service; accuracy and efficiency of computerized returns without having to use input sheets, questionnaires, or mailing of forms to a computer service; same day service on returns, with many referrals; program fully complies with the AICPA recommendations for computerized tax preparation.

To use the MTP, you will need an 8080-based microcomputer system with 48K of memory, one disk drive (we recommend two), a video terminal with an 80 character by 24 line display and direct cursor positioning capability (such as the Soroc IQ-120, Hazeltine 1500, ADM-3a, or ADDS), and either North Star BASIC, or CP/M and Microsoft BASIC or CBASIC-2.

Also, you will need a printer. We suggest that you use an intelligent letter-quality printer such as a Diablo, Qume or NEC Spinwriter. These printers have two advantages. First, you can use individual sheets of paper or continuous (tractor feed) forms. Second, printing can be greatly sped up by using the version of the MTP which uses the "escape sequences" that these printers understand.

MASTER TAX PROGRAM

The Master Tax Program offers computerized preparation of Schedules A, B, C, D, E, G, R, RP, SE, TC and Forms 2210, 4797, 4625, 4726, 2106, 2441 and 1040. In addition, it offers inclusion of tax tables A, B, C, and D; tax schedules X, Y, and Z; and sales tax and gas tax tables for your state.

Some of the features of the MTP are as follows:

- 1% and 3% medical limitation incorporated
- Automatic checks for FICA overwithholding
- Automatic earned income credit calculation
- City/Sales tax carried over to Schedule A
- Depreciation calculation for all rates
- Schedule TC automatically generated when appropriate
- Tax preparer's Federal ID# and employee's Social Security number are automatically typed on 1040

Schedules may be prepared in two ways. First, the schedules may be loaded and run individually. Second, each schedule will automatically run, or "chain," any associated schedules if desired. This is recommended, in that no schedules are accidentally left out in preparation.

The main strength in the MTP package is that all data entry sequences are entirely form-oriented. In other words, the computer will display 24 lines of the appropriate schedule or form and position the cursor for input in the correct spaces. The total effect is very close to actually filling out the schedule, the only difference being that the computer automatically performs all computations.

All information entered may be stored on diskette for use or access at a later date.

Using the form-entry, preparation of forms is very quick and manual errors are greatly reduced. Most tax packages require the use of an entry sheet or questionnaire-type form to put the information in order before it is entered into the computer. The forms-entry formatting in this package eliminates the need for such questionnaires.

Also, since tax information changes on a yearly basis, the user of the tax packages may receive yearly updates by paying a modest subscription fee to CPAids.

CONCLUSIONS

This package is very well designed and implemented. Microcomputers are well suited to this application and can be very cost effective. If an accountant has a heavy tax season, he should be able to purchase a computer solely to aid in tax preparation and pay for it in one season with additional business. One accountant we spoke with claims to have increased his tax-season income from around $12,000 to over $30,000 by the use of a microcomputer with a similar preparation package.

Additionally, once the computer has paid for itself, you can purchase programs such as client time and billing, word processing, or client write-up programs which will be of use through the entire year.

The Master Tax Program, a Standard Tax Program (including schedules A, B, C, D, E, G, R, RP, SE, TC and Forms 2106, 2441), a Payroll Package, Tax Planning Aids Package, and an Accountant's Write-up Package are available from CPAids, 1640 Franklin Avenue, Kent, OH 44240, (216) 678-9015.□

Bob Johnson has been an alternating author of this column. Carl Heintz will now be writing Business Software Review each month. He can be contacted at 2540 Huntington Drive, San Marino, CA 91108.

Radio Shack introduces its second TRS-80™ computer breakthrough. A small-business computer for people who like to pay less than the "going price".

Why Radio Shack's "going price" is so much lower

There's TRS-80 Model I. Systems start at $499. Last year they started at $599, but now we're down the learning curve while others are just starting up. This ad, of course, is not about Model I. It's about Model II. Model II systems start at $3450. It's an all 8" floppy disk system: one built in, room for three more. True 12" monitor, twice the size of the IBM 5110, for example. Twice the operating speed of Model I. Upper and lower case. New state-of-the-art 76-key keyboard. Level III expanded BASIC. And here's what's so incredible: comparable systems (like IBM 5110) cost roughly 33% to 66% more. We said we'd tell you why; it's a mix of three possibilities: (1) they have higher selling costs, (2) they have higher manufacturing costs, (3) we have lower gross margins.

A small business may be a small part of a large business, right?

Most businesses, small or large, have a tendency to buy too much computer for their job. We learned about this with TRS-80 Model I; in fact Model I is too little computer for many business applications. So we designed Model II to be "just enough computer" for most micro/mini applications. And here's a promise: we'll sell you what you need, not less, not more, and you will SAVE MONEY.

Does a retailer belong in the business-computer business?

The competition would like you to believe computers can't be sold over the counter like typewriters. They're right! Business computers like TRS-80 Model II have to be sold where computers and software are sold, where computers are serviced, where computer advice is available directly from the manufacturer. That, friend, is exactly what Radio Shack is all about.

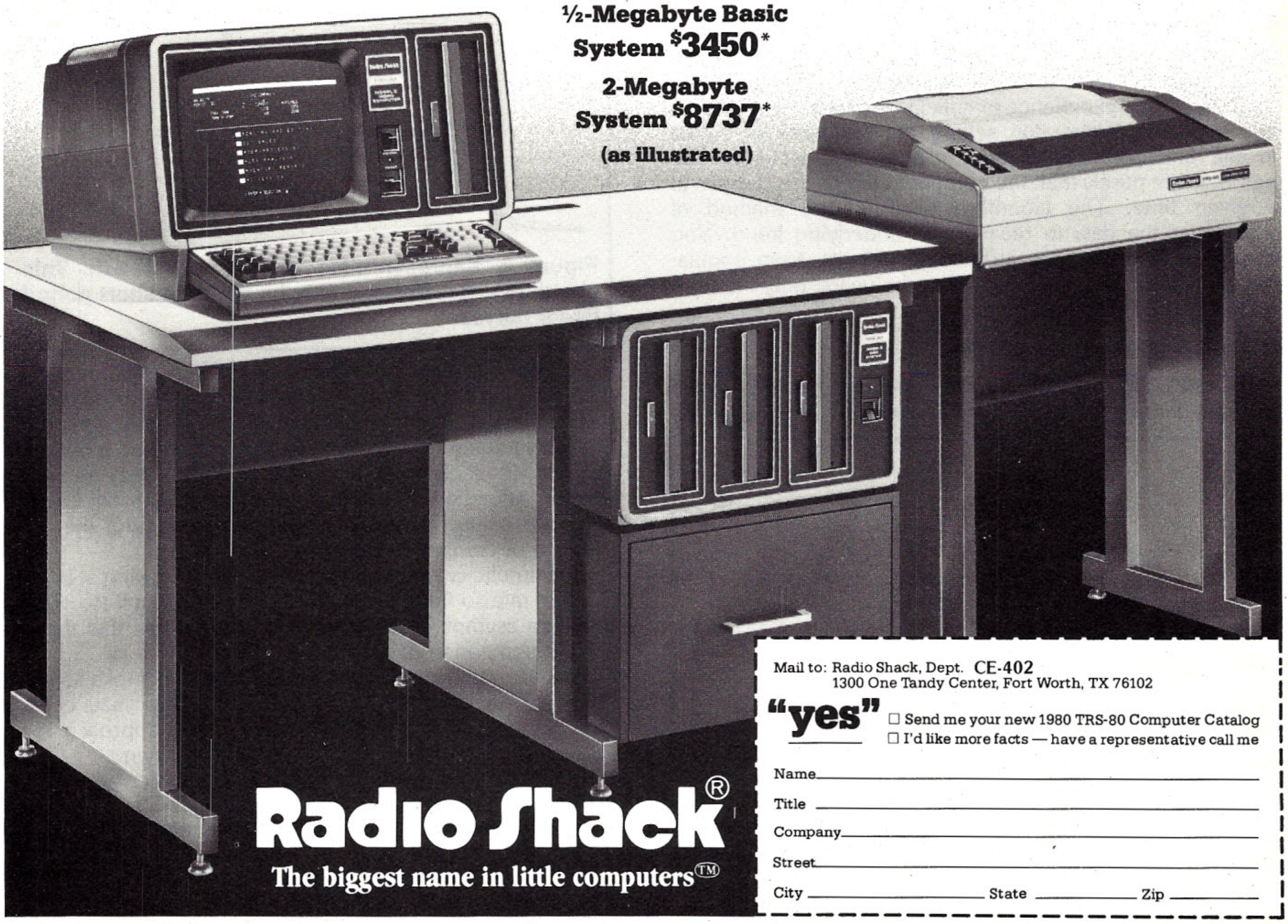
How we sold over 100,000 TRS-80 Model I Systems

This is probably the most interesting computer story never told. We did not know—repeat NOT know—there was a big market for personal computers. So we put 20 people on the job. Shortly thereafter we had over 700 people on the job. The over 100,000 system sales came from getting off our behinds FAST and meeting demand by building computers (instead of talking about them).

Radio Shack deserves to be your small-computer company!

Simply because we offer 5-figure computing power at a 4-figure price—with five business software packages ready to "go to work" immediately—with your existing personnel. Plus, modular design means easy expandability with plug-in printers, additional disk drives and more! You can order a TRS-80 Model II (or I) in over 7300 locations worldwide. And, over 100 USA Computer Sales/Service centers are ready to stand behind your computer with service (and training classes, if you wish). There's so much to tell about TRS-80 II, we urge you to come in today and get all the facts, firsthand!

* Retail prices may vary at individual stores and dealers.



½-Megabyte Basic System $3450*

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FORECAST: Volume Projection for the Small Business

By Leo P. Biese, M.D.

The prediction of future volume is an important management tool for business. A multinational corporation may employ a staff of analysts and programmers to predict future sales to the highest degree of accuracy possible, but in small businesses forecasting is no less important.

For the manufacturer, the projected volume governs the procurement of raw materials and parts, personnel requirements, and perhaps capital expenditures, to mention only a few areas.

For the retailer, projection is needed to anticipate changes in necessary stocks, as well as cash flow and staffing. Even the purely service-oriented business can make good use of volume projections.

The traditional method of making projections consists of displaying past performance as a large graph behind the president's desk. The analysis and subsequent projection is then made by taking an "eyeball guesstimate." Depending upon the nature of the past data and upon the experience and acumen of the estimator, the guess may offer varying degrees of accuracy.

The problem is that the basic underlying trend upon which the projection is based is often hidden in a background of statistical noise generated by seasonal, as well as apparently random, variations. The mathematical analysis of time-series trends is a set of tools to reduce this noise much in the same way that electronic signal averaging is used to extract a given signal from its background noise.

The analysis of trends has no inherent unit and it makes no difference if we are talking about projecting gross sales in dollars or actual items sold. The material in this article is based on the author's experience in anticipating future test volume in a large clinical laboratory setting, but it is just as applicable to the anticipated sales of a widget manufacturer. The numbers are purely that: the number of things that happen at a given time. The algorithm used is one method of smoothing the data to recover the underlying trend. You could just as easily plug in building permits, town populations, or even your golf score over the years; only the titles on the printout change.

PATTERNS OF GROWTH

Growth occurs in one, or a combination, of three basic patterns (Figure 1). In LINEAR growth, the rate is constant

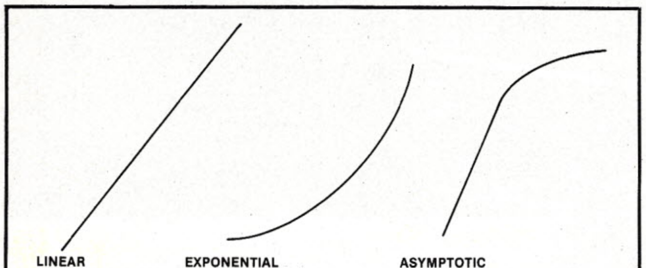

Figure 1. Patterns of Growth

and presents no analytical problems, since it can easily be projected visually. Unfortunately, linear growth is rarely sustained except for short periods of time and under special circumstances. The usual methods of volume projection often assume linear growth, but when the noise due to volume fluctuations is suppressed by various smoothing techniques, it can be readily shown that growth was linear over only a short period of time and any projections based on this would be very misleading.

In EXPONENTIAL growth, the rate is constantly increasing. This represents, for example, the desirable situation when every satisfied customer brings in three new customers. Unfortunately for business, this pattern is also rarely sustained for very long.

ASYMPTOTIC decline is another common pattern in which growth starts out briskly (perhaps in a linear manner), but the rate of growth slows gradually, even though the total volume keeps increasing, as the market becomes saturated. This represents the situation where "almost everyone's got one." Identification of this type of pattern would be important, for example, to determine at what point further increases in sales would no longer make it worthwhile to continue manufacturing the product.

SIGMOID growth represents the real world. Sigmoid, or "S"-shaped growth is actually composed of parts of the other three types of growth. It is the most common representation because it reflects the external events that influence growth. A new product is introduced and its rapid acceptance produces a period of exponential growth in a hungry market (Figure 2).

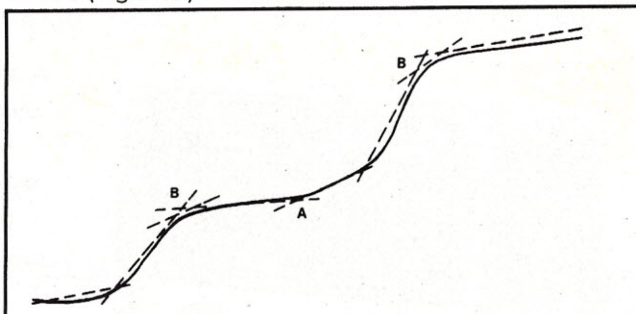

Figure 2. Representative Compound Growth. This could be approximated only by multiple short period linear curves.

At point A, the curve changes direction (called an inflection point); the period of rapid growth is over and the product then enjoys a steady period of linear acceptance. At point B the curve again changes and the product enters a period of asymptotic decline in new sales. Point B may represent market saturation or external events such as product obsolescence owing to new technology, overpricing, the introduction of competition, and so on.

Asymptotic curves are ones that keep increasing at an ever smaller rate so that they approach, but never get to, 100%; they are asymptotic because of Barnum's rule that there is always someone out there who needs/wants one.

Actual growth curves are often a combination of a series of these different patterns. High inflation rates may change linear growth into asymptotic decline only to approach linear growth once again as interest rates come down.

Microcomputer mainframe sales is an excellent example in which the full sigmoid curve completed itself in just three years with the introduction of the chips and saturation of the hobby market, but is now (slowly) repeating that same sigmoid curve with the acceptance of the microcomputer by the small business community.


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Unaudited Statements
For Management Use Only

It is this type of compound curve that is the most difficult to appreciate visually and the most difficult one to project over long periods of time, precisely because the analyst cannot predict the occurrences of outside stimuli and their affect on volume. Unfortunately, no computer program can do that. You could have had huge amounts of sales data for 1950 and never predicted the results of the advent of the transistor nor the effects of Japanese competition a decade later. Time-series forecasting can, however, go a long way towards reducing the errors in deciding where you are probably going by looking at where you have been.

SMOOTHING TECHNIQUES

A fairly typical pattern of sales is shown in Figure 3. The underlying growth trend is obscured by week to week fluctuations. About all we can say for the period shown is that

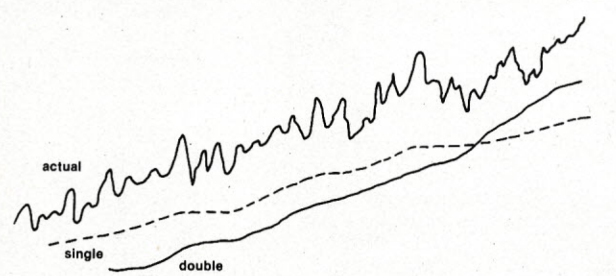

Figure 3. Unsmoothed, Single and Double Smooth Data (Redrawn after Westlake)

"sales are up" — not a very satisfactory way of deciding how many units we should make/buy for the coming period. There may also be significant seasonal trends hidden in here, which will be discussed later.

The simplest technique to reduce random fluctuations would be to compress the units of volume used. If the unit volumes were great enough, we could plot thousands sold instead of hundreds sold, effectively rounding off the data. It may very well be, however, that such a crude attempt at smoothing would be worthless, since we can't plan on the basis of thousands of units because the components are too expensive. It is at this point that the appropriate mathematical techniques can be helpful.

MOVING AVERAGES

In all the mathematical techniques of smoothing, we use some variation to take the average between two successive periods and weight (i.e., adjust) this difference in some manner so that it can be applied to the next following period. The difference between methods lies in how we derive this adjustment and how heavily we apply it. As will be shown later, we can adjust to the point where our data is no longer significant because it no longer provides the information we need.

The moving average is the least destructive of the smoothing techniques. It is found by taking the simple average of some number of past periods and using that as the prediction for the average of the next period. Note that this is not the same as "simple averaging" because it is reapplied with each new period or group of periods and hence the average is continually changing.

We can, for example, take the sales data per month for the past six months, average it, and use this average as the prediction for the next month. In this specific case:

$$\text{predicted ave. July sales} = \frac{\text{actual sales Jan-June}}{6}$$

To smooth the curve over many periods, we simply keep repeating the process for as long as we have data; the average sales for Feb.-July becomes the predicted sales for August, etc. Three important factors are at work here: 1) *the degree of smoothing depends upon the number of periods chosen,* and 2) *the periods before that have no affect on the smoothed curve.* At the same time, 3) *the ability to predict change is inversely proportional to the number of periods chosen.*

To put it another way: For any given year, the closer we select the data intervals (monthly, biweekly, weekly) the:

1. smoother the curve is,
2. less able the curve is to predict short-term changes, and
3. greater the curve is in predicting long-term (e.g., yearly) trends
4. predictions for, say, August are based on actual sales for Feb.-July and are not influenced by actual sales in January, no matter how high or low they were.

The effect of using different numbers of periods for calculating the moving average is shown in Figure 4 where using monthly data over a period of five years shows a definite seasonal pattern that is eliminated by using weekly sales data.

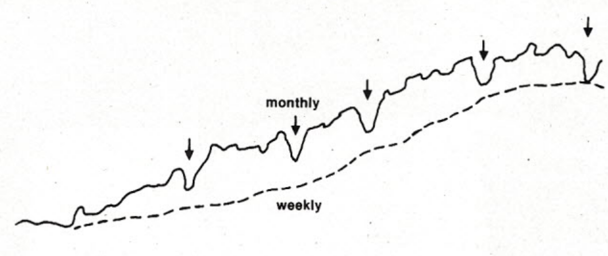

Figure 4. Effects of Loss of Periodic Data by Smoothing with Weekly Moving Average and Monthly Moving Average. (Redrawn after Westlake)

Greater smoothing can be obtained by repeating the process a second or even a third time on the previously smoothed data, but other techniques are usually more appropriate. In addition, we can increase the ability to show *changes* in trends (inflection points) by adding the difference between the first and second smoothing . . . back to the first smoothing; a process called "double moving averaging."

Consider the curves in Figure 3: the smoothed curve (moving average) lags behind the actual data by a period of three months because we needed the first three months to get the first moving average. If we now perform a second smoothing by taking a moving average of the moving average, this new curve would lag the first curve by an additional three months.

Now if we took the difference between the first moving average and the second moving average and added it back to the first, some of the lag is erased. The first smoothing is unaffected, but the changes (inflection points) which were largely suppressed by the second smoothing are enhanced! The formulas for doing this are given as remark statements in the program that follows.

EXPONENTIAL SMOOTHING

In this method we take the difference between the actual volume for a given period and the predicted volume for the same period and add a fixed portion (weighting factor) to the forecast for the *following* period. In this manner we continually correct the curve on the basis of past experience. This could be viewed as a kind of "self-correction" forecast which "learns" by its own past experience. The percentage of difference (weight) remains the same, but unlike the moving average, the correction applied to each period is influenced by all the previous points in the database.

The weighting factor can be anything between 0 and 1. The smaller the value, the greater the smoothing effect. This is subject to the same limitations discussed above, i.e., the smaller

the weight factor, the greater the smoothing and the less subject the curve is to short-term changes. In general, weighting factors of about .2-.3 give good results, but several should be tried. As in the moving average, we can apply the process a second or third time. Double exponential smoothing is performed similarly to double moving averaging, and is probably the best smoothing procedure available for general use. This is the method used in the program to follow.

A glance at the program calculations will serve to convince you that double exponential smoothing of a monthly five-year sales record (60 points) is an excellent reason in itself for owning a micro, since doing it by hand would result in the forecasting period being over by the time the calculations were done. A few additional titles and form feeds and you can have the annual report done in less than five minutes.

LINEAR REGRESSION

This is a method often mentioned for projecting future volume; it is brought up here only to condemn it. As we have seen, actual growth is very rarely linear except for small periods of time (months) and very serious errors can occur when attempting to use this method unless very elaborate statistical tests are used to evaluate the "fit" of the derived formula to the observed curve.

SEASONAL ADJUSTMENT

As was mentioned above, the purpose of smoothing techniques is to minimize the effects of noise fluctuation and show the underlying growth trends. This smoothing affects not only the pseudo-random variations in volume, but seasonal (periodic) variations as well. In many instances it is desirable to preserve this seasonal information in order to refine further the projection process. There are many mathematical techniques for recovering periodic information, but their various merits will not be discussed here. Fortunately, one of the most easily understood and easiest to apply, called seasonal indexing, is quite satisfactory for our purposes.

A Seasonal Index is constructed by first performing a single moving average as described above, usually a 12-month moving average, since we want to use the least destructive smoothing procedure and so preserve the maximum seasonal information. The unadjusted index for each period is then the actual volume divided by the predicted volume:

$$\text{raw index P} + 1 = \frac{\text{actual volume period P}}{\text{predicted volume period P}}$$

Next we find the medial average for the year by discarding the highest and lowest raw indexes and averaging the remaining values. The "adjusted" seasonal index is then each raw index minus the average index, and this can be used as a factor to multiply the projected volume for each period. Further refinements include various weighting techniques. The reader is encouraged to consult the references listed. Seasonal indexing has not been incorporated in the program presented.

ABOUT THE PROGRAM

The program is written in Microsoft BASIC 4.1 running under the CP/M operating system. The program is interactive with a floppy disk drive; old data may be called up and added to at any time or viewed and then corrected, since this is considered essential in a business environment. The program is reasonably fast, so that multiple trial runs with different smoothing factors can be accomplished; it takes about five minutes for a complete run with a 300 cps printer. Some error traps have been programmed, but no effort was made to make these complete.

The graphic output is modified from the author's generalized program module GRAPH: for the display of non-formula X-Y data. The horizontal and vertical axis has been changed with volumes and periods adapted for this specific purpose. The volumes are in equal increments declared during the run.

For biweekly or weekly data, only about 105 periods can be printed on 14" wide paper, while 36 monthly periods print out at intervals of three spaces each. The vertical (column) axis is limited to about 52 lines, and you must set the interval (II) within this to avoid running off the paper.

This section is presented as an example only. The reader must furnish his own subroutines for significant changes for data outside these ranges.☐ **Program follows**

REFERENCES

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Brown, R.G.; *Smoothing, Forecasting and Prediction of Discrete Time Series.* Prentice-Hall, Englewood Cliffs, New Jersey, 1963

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Wheelwright, S.C., and Makridakis; *Forecasting Methods for Management* John Wiley and Sons, New York, 1973

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ABOUT THE AUTHOR

Leo P. Biese is a physician, pathologist and currently director of an independent laboratory in New England.

His hardware consists of two mainframes based on the 8080 processor with 64 and 48K memory, ADM-3a and SSM video terminals, and a DECwriter printer, all running with three 8" floppy (Pertec) drives through Tarbell controllers.

PROGRAM LISTING

```
100 'FORCAST: A program to predict future test volume given sufficient
     data on past performance; based on the article by George Westlake
     in: MANAGEMENT AND COST CONTROL TECHNIQUES FOR THE CLINICAL LAB.;
     University Park Press,1977

110 'Programmed in Microsoft Basic for the CP/M operating system.
     All comments should be directed to:  Leo P. Biese,MD
                                          RFD 1,Murray Hill Road
                                          Hill, NH 03243

120 'NOTE: you must have at least one dummy 'xxxxxxx.DAT' file on the
     disc to prevent a file-not-found error. The data files should be
     created with this program itself to load correctly.

130 CLEAR 1000                                    'Get some string space
140 SIZE=52                                       'Dim to No. of periods
150 DIM P(SIZE),V(SIZE)
160 DIM S1(SIZE),S2(SIZE),D(SIZE)
170 PRINT CHR$(26)                                'Clear ADM screen

180 PRINT"PROJECTION OF FUTURE LABORATORY TEST VOLUME/REVENUE"
190 PRINT"  You are dimentioned to no more than "SIZE"periods."
200 PRINT"-------------------------------------------------------"
210 PRINT:PRINT

220 PRINT"THE DATA FILES AVAILABLE FOR THIS PROGRAM ARE:":PRINT
230 FILES "*.DAT"
240 PRINT:PRINT
250 PRINT"ENTER A FILENAME (WITHOUT .DAT EXTENTION) TO USE A FILE";:
    PRINT" FROM THE"
260 PRINT"      LIST ABOVE or CARRAGE RETURN TO START A NEW FILE OF DATA"
270 PRINT:PRINT
280 PRINT"OLD FILE NAME  ?  ";
290 LINEINPUT X$
300 IF X$="" THEN PRINT:LINEINPUT"NEW FILE NAME (8 CHARS)  ? ";X$:
          X$=X$+".DAT":B=1:GOTO 410

310 '--------------- User wants an old file, get it

320 X$=X$+".DAT"
330 OPEN "I",#1,X$
340 INPUT #1,N,A0,A9
350 FOR I=1 TO N:
      INPUT #1,V(I):
      NEXT:
      CLOSE

360 '--------------- Data entry and review

370 PRINT
380 INPUT"DO YOU WANT TO ADD TO THE CURRENT DATA  ";Q$
390 IF LEFT$(Q$,1)="Y" THEN B=N+1:
    PRINT:GOTO 460                                'B=Start of new data
400 PRINT:GOTO 620                                'No, use old data

                Start a new data file

410 A0=2E+10:A9=2E+10                             'init. hi/lo counters
420 B=1                                           'we are not adding data
430 PRINT"BEGIN ENTERING YOUR DATA NOW"
440 PRINT"PERIODS MAY BE:  WEEKLY,MONTHLY,YEARLY OR ANY OTHER INTERVAL."
450 PRINT"     RESULTS WILL BE IN TERMS OF THE SAME PERIODS."
460 PRINT:PRINT"IF YOU MAKE AN ERROR ENTER 999, ";
470       PRINT"TO END DATA ENTRY USE 000":PRINT
480 FOR I=B TO 2E+10                              'cont. till told to stop
490    IF I/20=INT(I/20) THEN PRINT:PRINT         'But remind the user
500    PRINT "PERIOD";I;"= ",
510    INPUT V(I)
520          IF V(I)=999 THEN PRINT:PRINT"REDO ";:GOTO 500
530          IF V(I)=0 THEN N=I-1:GOTO 590
540          IF V(I)>=A0 THEN 560
550             A0=V(I)                           'tag lowest value A0
560          IF V(I)<=A9 THEN 580
570             A9=V(I)                           'and highest A9
580    NEXT
590    PRINT:PRINT

600 PRINT"                  *** DATA ENTRY COMPLETE ***":PRINT

610 '--------- User may want to check the old data

620 INPUT"DO YOU WANT TO REVIEW THE DATA FOR ERRORS  ";Q$
630 IF LEFT$(Q$,1)<>"Y" THEN 880
640 PRINT:PRINT

650 FOR I=1 TO N                                  'Yes,print it out
660    PRINT USING "###";I;
670    PRINT") "V(I),
680    NEXT
690 PRINT:PRINT:INPUT"CORRECT";A$
700 IF LEFT$(Q$,1)<>"N" THEN 750
710 PRINT:INPUT"CHANGE WHICH VALUE ";I
720 INPUT"WHAT IS THE CORRECT VALUE  ";Z
730 V(I)=Z:GOTO 640

740 '---------- Save the final version of the data

750 PRINT CHR$(26):PRINT"SAVING '";X$;"' ON THE DISC.....":PRINT
760 OPEN "O",#1,X$
770      PRINT #1,N,A0,A9
780      FOR I=1 TO N
790          PRINT #1,V(I)
800          NEXT
810          CLOSE

820 '::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

830 'Calculations. Note: the calculations given are for three-period
840 'exponential smoothing. If simple smoothing is desired substitute
850 'the following or add as a subprogram:

            S1(P+1)=(V(P)+V(P-1)+V(P-2)....+V(P-N))/N
            S2(P+1)=(S1(P+1)+S1(P)+S1(P-1))/3
                   D=((2*S1(P+1))-S2(P+1))+((2/N-1))*(S1(P+1)-S2(P+1)))

860 'Where V=volume, P=period, S1=first smoothing, S2=second smoothing
     and D=double smoothing.

870 '::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
880 PRINT:INPUT"SMOOTHING FACTOR DESIRED (0-1)      ";F:PRINT
890 IF F>1 THEN PRINT:GOTO 880

900 '---------- Calculations. Note: with 3-period smoothing
               S1,S2 are invalid for the first period and
               D for the first two periods.

910 S1(1)=V(1):S2(1)=V(1)                         'initialize
920 FOR P=2 TO N
930     S1(P)=S1(P-1)+(F*(V(P-1)-S1(P-1)))        '1st. smoothing
940     S2(P)=S2(P-1)+(F*(S1(P)-S2(P-1)))         '2nd. smoothing

               now double-smooth with factor F
```

```
950      D(P-1)=(((2*S1(P))-S2(P))+((F/(1-F))*(S1(P)-S2(P))))
960      NEXT

970 '--------------- Tabular printout of data.

         In the cp/m system a 'PRINT' command is directed to the
         assigned console (CRT) and an 'LPRINT' is sent to the LST
         device (printer)

980 INPUT"WHAT IS THE TITLE OF YOUR DATA";Q1$

990 PRINT"ADJUST YOUR PAPER, TURN ON THE PRINTER and then hit 'RETURN'"
1000 INPUT"                    READY ??           ";Q$
1010 LPRINT
1020 LPRINT SPC(6);"EXPONENTIAL SMOOTHING OF LABORATORY TEST  VOLUME"
1030 LPRINT SPC(15);"     USING A FACTOR OF 0"F
1040 LPRINT
1050 LPRINT Q1$
1060 LPRINT STRING$(LEN(Q1$),"="):LPRINT
1070 LPRINT"PERIOD","VOLUME","1ST. SM.","2ND. SM.","DOUBLE"
1080 LPRINT" (P)"," (V)"," (S1)"," (S2)"," (D)"
1090 LPRINT STRING$(64,"-")
1100 J=1
1110 FOR K=1 TO N
1120      LPRINT " ";K,V(K),
1130      IF K=1 THEN LPRINT SPC(2);CHR$(45);CHR$(45),SPC(2);CHR$(45);
          CHR$(45), SPC(2);CHR$(45);CHR$(45):J=J+1:GOTO 1170
1140      LPRINT INT((S1(K)+.5)),INT((S2(K)+.5)),
1150      IF J<3 THEN LPRINT SPC(2);CHR$(45);CHR$(45):J=J+1:GOTO 1170
1160      LPRINT INT((D(J-1)+.5)):J=J+1
1170      NEXT
1180 LPRINT STRING$(64,"-")
1190 FOR I=1 TO 6:LPRINT:NEXT                      'eject paper
1200 '---------------- define graph parameters

1210 WIDE=120:HEIGHT=54:                           ' 14"x11" paper
1220 WIDTH 130
1230 SCALE=INT((A9-A0)/HEIGHT)                     'vertical interval
1240 PLACE=INT(WIDE/N)                             'horizontal tabs
1250 PRINT CHR$(26)
1260 PRINT"SET UP THE PARAMETERS FOR GRAPHIC OUTPUT"
1270 PRINT STRING$(40,45):PRINT
1280 PRINT"YOUR DATA RANGES FROM ";A0;"to";A9;"or";A9-A0 "UNITS IN ALL"
1290 PRINT
1300 INPUT"SELECT AN EVEN RANGE FOR THE GRAPH: LOWEST VALUE   ";AL
1310 INPUT"                                       HIGHEST   ";AH:PRINT
1320 PRINT"THE GRAPH WOULD BE";HEIGHT;" DIVISIONS HIGH or";
1330 PRINT INT((AH-AL)/HEIGHT);" UNITS/DIV.":PRINT
1340 PRINT
1350 INPUT"SELECT AN EVEN NUMBER OF UNITS/DIV (CAN'T BE LOWER)    ";I1
1360        IF I1=0 THEN I1=INT((AH-AL)/HEIGHT):GOTO 1380
1370        IF I1<INT((AH-AL)/HEIGHT) THEN PRINT:PRINT"WON'T FIT,";:
            PRINT "MUST BE >";:GOTO 1330
1380 PRINT CHR$(26):PRINT STRING$(72,45):PRINT
1390 PRINT"     YOUR GRAPH WILL RUN FROM "AL"to"AH" ON THE VERTICAL AXIS"
1400 PRINT"     WITH EACH DIVISION =";I1;"UNITS":PRINT
1410 PRINT"     THE HORIZONTAL RANGE IS FROM ZERO TO"WIDE"AND YOU";
            :PRINT" HAVE"N"POINTS"
1420 PRINT"     WITH EACH DIVISION =";PLACE;"UNIT";:IF PLACE >1 THEN
            PRINT"S" ELSE PRINT
1430 PRINT:PRINT STRING$(72,45):PRINT:INPUT "CORRECT  ";Q$
1440 IF LEFT$(Q$,1)="N" THEN PRINT CHR$(26):
     PRINT"BEGIN GRAPH DEFINITION AGAIN":FOR I=1 TO 5:
     PRINT CHR$(7);:FOR J=1 TO 100:NEXT J,I:PRINT:GOTO 1280

1450 '---------- Now print the graph

1460 X=2' Start counter and print only alternate margin values

1470 PRINT:INPUT"ADJUST PRINTER AND HIT RETURN TO START ";Q$

1480 FOR I=AH TO AL STEP -I1
1490      IF X/2=INT(X/2) THEN LPRINT USING "####";I;
          ELSE GOTO 1510
1500      LPRINT "-|";:GOTO 1520
1510      LPRINT TAB(5)"|";

1520      X=X+1                                   'counter for graph vert.
1530      IF X=8 THEN LPRINT TAB(15) Q1$;              'our graph title
1540      IF X=9 THEN LPRINT TAB(20)"SMOOTHING FACTOR = 0";F;
1550      FOR P=1 TO N-1'

          activate next 3 lines for plotting the unsmoothed data also

1560 '        IF V(P) <= I-(I1/2) THEN 1530
1570 '        IF V(P) >  I+(I1/2) THEN 1530
1580 '        LPRINT TAB(PLACE*P);"o";
1590          IF P<3 THEN 1630                     'first 2 D's invalid
1600          IF D(P) <= I-(I1/2) THEN 1630
1610          IF D(P) >  I+(I1/2) THEN 1630
1620          LPRINT TAB(PLACE*P);"x";
1630          NEXT: LPRINT

1640      NEXT I

1650 '---------- Now print a horizontal legend for the graph

1660 LPRINT SPC(5);
1670 IF PLACE=1 THEN LPRINT (WIDE,"-"):FOR I=1 TO WIDE STEP 5:
     LPRINT I:NEXT:GOTO 1800
1680 FOR I=1 TO (WIDE/PLACE)-3
1690      LPRINT "|-";
1700      IF PLACE=4 THEN LPRINT "--";
1710      IF PLACE=3 THEN LPRINT "-";
1720      NEXT: LPRINT

1730 '     the above prints the bottom margin only, the values
           must be provided by the user. The following is for
           a specific use.

1740 LPRINT SPC(7)
1750 FOR I=1 TO 3
1760      LPRINT"DC JN FB MR AP MY JN JL AU SP OC NV ";
1770      NEXT
1780      LPRINT
1790      LPRINT TAB(20)"1976"; TAB(60)"1977"; TAB(95)"1978"

1800 FOR I=1 TO 5:LPRINT:NEXT                      'eject the paper
1810 END


RUN #1   CREATING THE DATA FILE


RUN

PROJECTION OF FUTURE LABORATORY TEST VOLUME/REVENUE
  You are dimentioned to no more than  52 periods.
--------------------------------------------------------


THE DATA FILES AVAILABLE FOR THIS PROGRAM ARE:

DUMMY    .DAT
```

```
ENTER A FILENAME (WITHOUT .DAT EXTENTION) TO USE A FILE FROM THE
    LIST ABOVE or CARRAGE RETURN TO START A NEW FILE OF DATA


OLD FILE NAME  ?

NEW FILE NAME (8 CHARS)  ? PROFILE
BEGIN ENTERING YOUR DATA NOW
PERIODS MAY BE:  WEEKLY,MONTHLY,YEARLY OR ANY OTHER INTERVAL.
    RESULTS WILL BE IN TERMS OF THE SAME PERIODS.

IF YOU MAKE AN ERROR ENTER 999, TO END DATA ENTRY USE 000

PERIOD 1 =     ? 994
PERIOD 2 =     ? 1000
PERIOD 3 =     ? 1049
PERIOD 4 =     ? 1129
PERIOD 5 =     ? 895


              ......    etc


PERIOD 36 =    ? 1939
PERIOD 37 =    ? 000


                *** DATA ENTRY COMPLETE ***

DO YOU WANT TO REVIEW THE DATA FOR ERRORS  ? N

SMOOTHING FACTOR DESIRED (0-1)       ? .8

WHAT IS THE TITLE OF YOUR DATA? TOTAL TESTS/MONTH CHEM. SECT. B
ADJUST YOUR PAPER, TURN ON THE PRINTER and then hit 'RETURN'
              READY ??          ?

RUN #2 USING OLD DATA FILES


RUN

PROJECTION OF FUTURE LABORATORY TEST VOLUME/REVENUE
  You are dimentioned to no more than  52 periods.
---------------------------------------------------

THE DATA FILES AVAILABLE FOR THIS PROGRAM ARE:

DUMMY   .DAT  PROFILE .DAT
ENTER A FILENAME (WITHOUT .DAT EXTENTION) TO USE A FILE FROM THE
    LIST ABOVE or CARRAGE RETURN TO START A NEW FILE OF DATA

OLD FILE NAME  ?  PROFILE

DO YOU WANT TO ADD TO THE CURRENT DATA  ? NO

DO YOU WANT TO REVIEW THE DATA FOR ERRORS  ? YES

 1)  994       2)  1000      3)  1049      4)  1129      5)  895
 6)  1012      7)  1095      8)  1024      9)  937      10)  949
11)  1109     12)  1100     13)  877      14)  994      15)  913
16)  1064     17)  961      18)  847      19)  1003     20)  864
21)  1279     22)  1361     23)  1442     24)  1520     25)  1440
26)  1316     27)  1398     28)  1767     29)  1858     30)  1797
31)  1800     32)  1614     33)  1699     34)  1579     35)  1520
36)  1939

CORRECT? YES

SET UP THE PARAMETERS FOR GRAPHIC OUTPUT
----------------------------------------
```

```
YOUR DATA RANGES FROM  847 to 1939 or 1092 UNITS IN ALL

SELECT AN EVEN RANGE FOR THE GRAPH: LOWEST VALUE  ? 830
                                    HIGHEST  ? 1950

THE GRAPH WOULD BE 54  DIVISIONS HIGH or 20  UNITS/DIV.


SELECT AN EVEN NUMBER OF UNITS/DIV (CAN'T BE LOWER)   ? 20

--------------------------------------------------------------------------

    YOUR GRAPH WILL RUN FROM  830 to 1950  ON THE VERTICAL AXIS
    WITH EACH DIVISION = 20 UNITS

    THE HORIZONTAL RANGE IS FROM ZERO TO 120 AND YOU HAVE 36 POINTS
    WITH EACH DIVISION = 3 UNITS

--------------------------------------------------------------------------

CORRECT  ? YES

      EXPONENTIAL SMOOTHING OF LABORATORY TEST  VOLUME
                   USING A FACTOR OF 0 .8

TOTAL TESTS/MONTH CHEM. SECT. B
===============================
```

PERIOD (P)	VOLUME (V)	1ST. SM. (S1)	2ND. SM. (S2)	DOUBLE (D)
1	994	--	--	--
2	1000	994	994	--
3	1049	999	998	1004
4	1129	1039	1031	1080
5	895	1111	1095	1191
6	1012	938	970	781
7	1095	997	992	1025
8	1024	1075	1059	1159
9	937	1034	1039	1010
10	949	956	973	874
11	1109	950	955	928
12	1100	1077	1053	1200
13	877	1095	1087	1138
14	994	921	954	754
15	913	979	974	1005
16	1064	926	936	878
17	961	1036	1016	1137
18	847	976	984	936
19	1003	873	895	761
20	864	977	961	1059
21	1279	887	901	813
22	1361	1201	1141	1500
23	1442	1329	1291	1517
24	1520	1419	1394	1547
25	1440	1500	1479	1606
26	1316	1452	1457	1425
27	1398	1343	1366	1229
28	1767	1387	1383	1408
29	1858	1691	1629	1999
30	1797	1825	1786	2020
31	1800	1803	1799	1819
32	1614	1801	1800	1802
33	1699	1651	1681	1502
34	1579	1689	1688	1698
35	1520	1601	1618	1514
36	1939	1536	1553	1454

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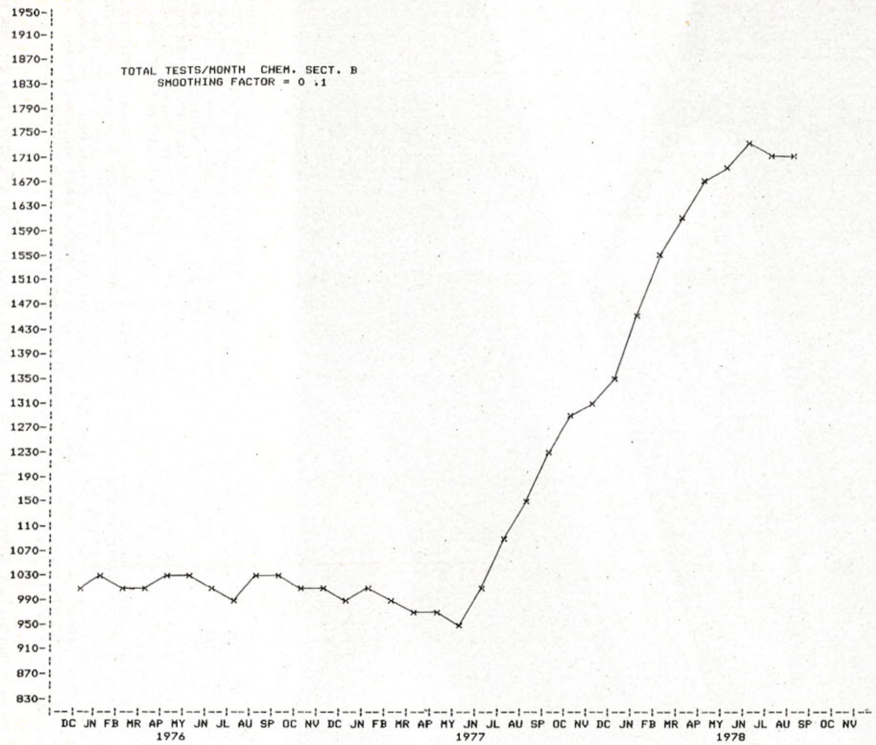

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TOTAL TESTS/MONTH CHEM. SECT. B

PERIOD (P)	VOLUME (V)	1ST. SM. (S1)	2ND. SM. (S2)	DOUBLE (D)
1	994	--	--	--
2	1000	994	994	--
3	1049	995	994	995
4	1129	1000	995	1006
5	895	1013	996	1031
6	1012	1001	997	1006
7	1095	1002	997	1008
8	1024	1012	999	1026
9	937	1013	1000	1027
10	949	1005	1001	1010
11	1109	1000	1001	998
12	1100	1011	1002	1020
13	877	1019	1003	1037
14	994	1005	1004	1007
15	913	1004	1004	1005
16	1064	995	1003	986
17	961	1002	1003	1001
18	847	998	1002	993
19	1003	983	1000	963
20	864	985	999	969
21	1279	973	996	947
22	1361	1003	997	1011
23	1442	1039	1001	1081
24	1520	1079	1009	1158
25	1440	1123	1020	1238
26	1316	1155	1034	1290
27	1398	1171	1048	1309
28	1767	1194	1062	1340
29	1858	1251	1081	1440
30	1797	1312	1104	1543
31	1800	1360	1130	1617
32	1614	1404	1157	1679
33	1699	1425	1184	1693
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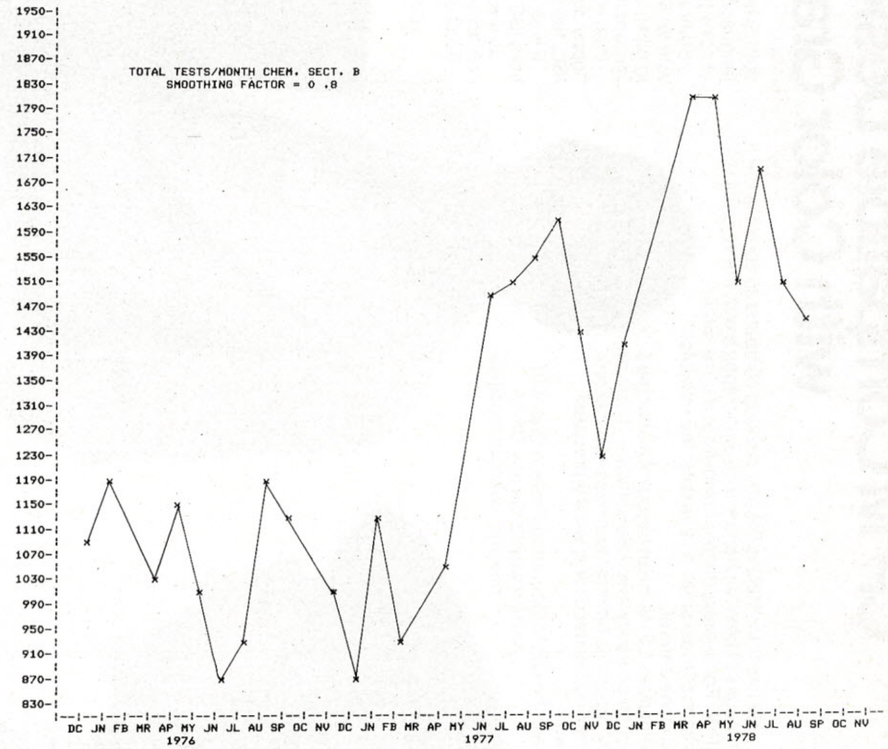

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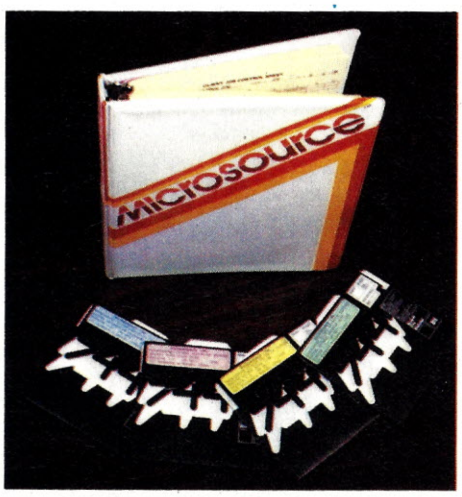

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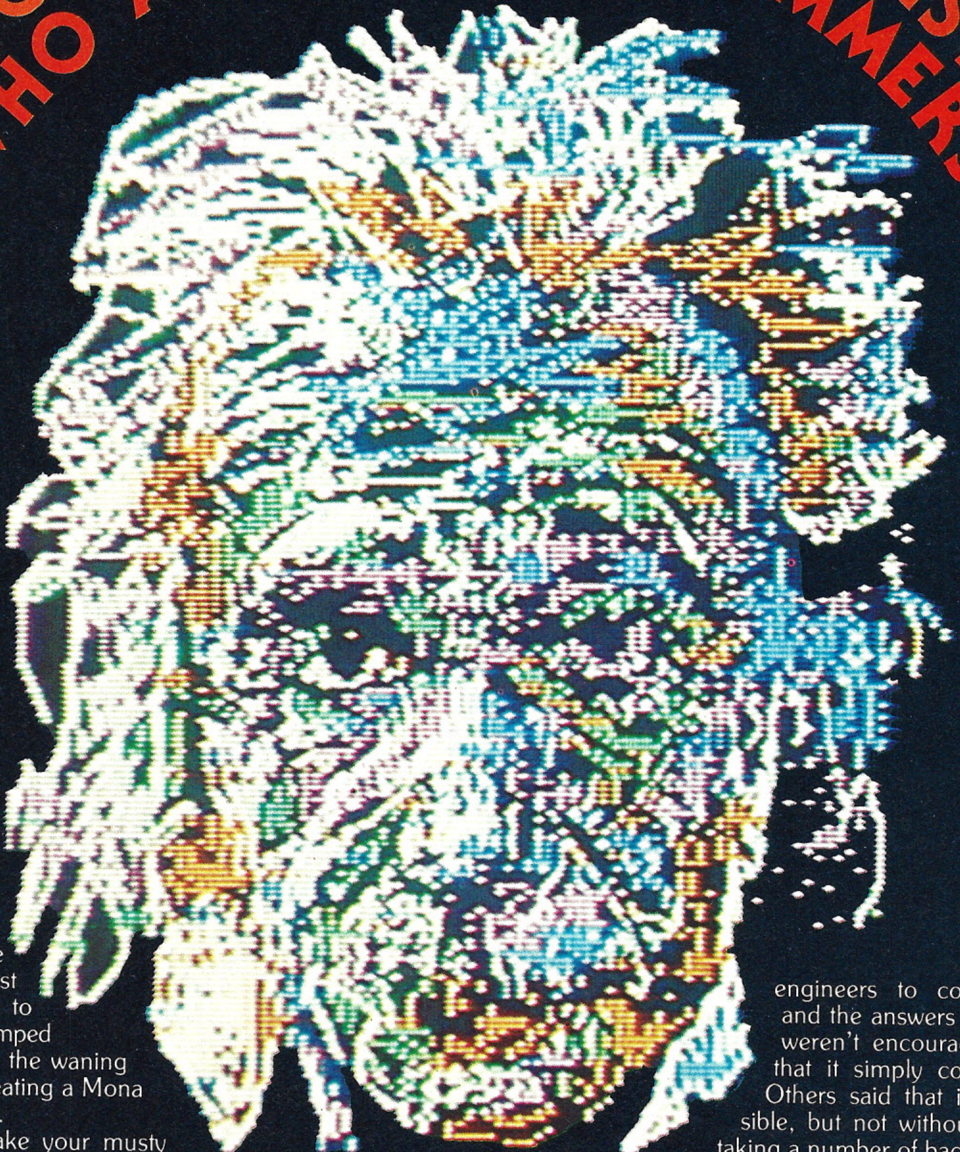
THE COMPUTERIZED ARTIST

A GRAPHICS UNIT FOR ARTISTS WHO AREN'T PROGRAMMERS



By
Betsy Gilbert,
Staff Reporter

There has always been an aura of mystery and romance surrounding the artist in society. We like to imagine him in a cramped garrett, painting by the waning light of the sun, creating a Mona Lisa or a Blue Boy.

Well, you can take your musty old romantic notions and put them away in the closet along with your 78 records, because they just don't hold water any longer. Today's artist is as modern as the age he lives in — the computer age — and he is as much affected by electronics as any of us.

Saul Bernstein, a commercial artist and teacher in the Los Angeles area, has made an ideal marriage between art and electronics. The union is not only making a tidy living for Bernstein; it is also opening doors to new roads in the future of art.

"It's been my dream for years to be able to put art into a computer," says Bernstein, an artist by profession for more than 20 years. "Don't ask me why," he adds, "because I've never had any working knowledge of electronics. It's just an idea that kept nagging at me."

Bernstein contacted a variety of technological types, from engineers to computer experts, and the answers they offered him weren't encouraging. Many said that it simply couldn't be done. Others said that it might be possible, but not without Bernstein first taking a number of background courses in computer science.

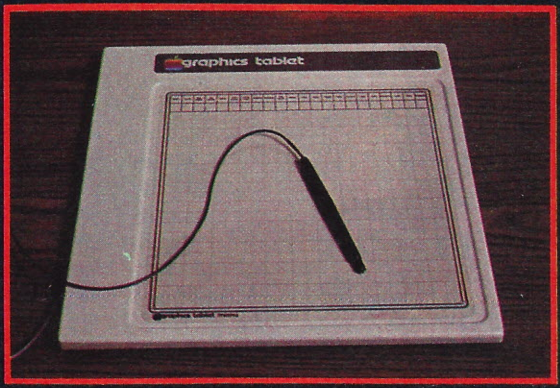
"I'm an artist, not a computer expert and I figured it was best to leave the science of computers up to those who were experts," he said. Still, he didn't give his idea up. It stayed in the back of his mind while he pursued his painting and teaching.

Then chance stepped in.

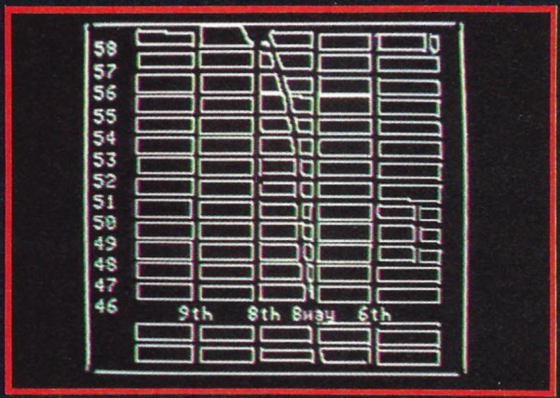
"I bought an Apple II in December 1978 just to play around with," Bernstein said. "It's a very simple system to operate — perfect for people like me who tend to be intimidated by things they don't understand."

A friend of Bernstein's daughter happened to be over one day when Bernstein was operating the Apple II and mentioned that her father sold computers for a living. That led to a meeting with the girl's father, Ron Mansfield, and the first step toward the realization of a dream.

The user can copy from an original or rough sketch, then add the corrections or final touches without having to redo the entire drawing.



The Apple Graphics Tablet.



The Apple Graphics Tablet can be used to assist in such diverse fields as fine arts like the Einstein sketch on the cover and this street map for New York City.

Mansfield told Bernstein that what he wanted to do was indeed possible. He set the artist up with a digitizer and Bernstein, using his television set as a monitor, got to work. Three days later, he gave his resulting disk to Mansfield, who made sure the people at Apple saw it. The rest, as they say, is history.

Using Apple's new graphics tablet and his own unique process of breaking a picture down in a technical, abstract way, Bernstein designed the cover, label, poster and commercial for the newly released Wayne Newton album. The striking design is turning heads in record stores around the world.

As Bernstein points out, the capability of drawing into a computer has been around for about 15 years, but it has not been done well until now. "This very simple, inexpensive system now offers artists like myself a whole new art form to explore and develop," he said.

Apple introduced its graphics tablet at this year's National Computer Conference in June. According to John Jones of Apple's marketing group, the response was everything the company had hoped for, and more.

"I don't remember any time during the show when we didn't have a crowd gathered around our demonstration area," Jones says. "Saul Bernstein was there to help us out and I don't think there was a single person who walked away from our booth unimpressed."

Jones feels the new product's appeal will be wide ranging. "Other companies sell graphics tablets, but no one else offers the software support and the complete operating system that we do," he says. "Also, I don't think there's any other manufacturer on the market who can match our price."

Apple took an OEM tablet and worked it into an easy-to-operate, affordable system. The total system, consisting of an Apple II (or an Apple II Plus) computer with 48K of memory, BASIC software, the graphics tablet and one disk sells for around $3,000. A standard color or black and white television set can serve as a monitor.

The system is ideal for drawing, lettering and low-level technical drawings. It offers a variety of choices for drawing modes and the BASIC language makes it easy for Apple to change the program to fit the needs of the user.

According to Jones, a finished product done with the tablet can be turned out in hours instead of the weeks sometimes required using drawing or painting modes. The user draws on the tablet and the image appears on the monitor. If he wants to make a change, he can take out any portion of the drawing simply by pushing a button, then resume his drawing in that area.

"When you think of what is involved in making a change in a sketch, or especially a painting, the simplicity of this system becomes even more impressive," says Jones.

In designing the Wayne Newton album cover, Bernstein tried several versions on the tablet and took Polaroid snapshots of each of them. The record company was able to choose the one they liked best and make suggestions for changes. Bernstein noted their changes, went back to the tablet and made them and was able to provide them with the new version promptly. Had he shown paintings instead, the modification process would have taken weeks.

"Time is money to a commercial artist," says Bernstein, "and the more time you save yourself, the more money you've made. My Apple system has already paid for itself several times over."

According to Jones, the current system, which is limited primarily to the drawing mode, will be enhanced in the future to provide a capability for diagramming on a higher technical level. In the meantime, the marketing effort will be aimed at artists like Bernstein.

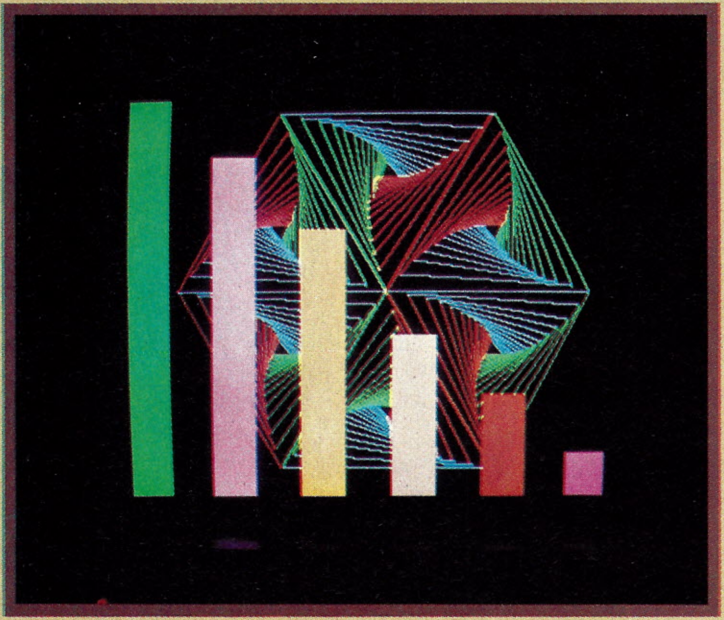
"I think it'll be the easiest product in the world to sell," says the artist. "Artists are generally scared to death of things like computers, but once people are made aware of just how simple this system is, I think you're going to see a lot more computer art."□

Cromemco's Superdazzler!

By Tom Fox, Systems Editor

The project was two years in the laboratory. Born in an engineering bull session or during a sleepless night or while viewing the climax of *2001: A Space Odyssey* — the origins are lost, now. People talk in two years. Engineers meet friends in other cities; programmers take advanced studies at nearby colleges. The word gets out.

The University of Oregon learns about it and wants one for neurological studies of a monkey's eyesight. They get it. Stanford University needs one for a PhD thesis. A deal is struck: Write us some software, you can have our developmental model. The prototype shop gets busy again. An urgent call from a Las Vegas casino: help us identify our high-roller check cashers. They're still working on that deal.



What kind of a machine elicits enthusiasm from such a wide range of people? It's obvious that these early users, whose excitement wouldn't allow them to wait for the production units, were fired up by more than the thrill of seeing yet another arrangement of parts on a circuit card. If analyzed, it could probably be shown that these people were excited not by a part they could hold in their hand; but by the potentiality of their own minds. "I need that machine because there's this idea I have, see — this *thing* in my head only I can see. Give me a way of showing it to you; make me a tool so I can pry it out and lay it on the table, that you can see what's painted on the inside of my eyelids."

What we are talking about is yet another card or two or three for the S-100 bus. But far more than just that, the SDI (a sophistication of the project name: Super Dazzler Interface) has been a vehicle to cut loose the imagination of nearly everyone who has come into contact with it.

The SDI corner of the Cromemco factory is more popular than the water cooler ever was. Visitors who know where the SDIs are plan their routes to include a look at the colorful screens. They are rewarded by a glimpse into the future of computers, for that is certainly the place for tools such as the Superdazzler.

COMPONENTS OF THE SDI SUBSYSTEM

In its simplest form, this high-resolution color graphics subsystem consists of a pair of SDI cards and a color monitor (a kind of a stripped-down color TV set). As we shall see later, performance of the system is enhanced dramatically by the addition of other hardware, but these two pieces are all that are really necessary to add a spectacular graphics capability to most any computer built around an S-100 bus.

The SDI subsystem will plug right into any Cromemco product (System Two, System Three, Z2-H, etc.). It should also be adaptable to nearly everyone else's machine, if careful attention is given to such things as port addresses and memory locations of the resident programs.

The two-card SDI set consists of a DMA Board and a Video Board, $595 the pair. The former is responsible for scanning the picture area of the computer's memory on a continuous basis and sending this information to the Video Board. The Video Board then interprets this digital information and converts it into analog signals, which are sent to the color monitor for display.

The color monitor must be of the "RGB" (named after the red, green and blue colors of its three electron guns), whose synch signals conform to the TV industry's EIA Standard RS-170. An RGB monitor is usually more expensive than the common "composite" color sets, but the quality of the display is far superior. Cromemco's 19-inch RGB monitor (supplied to them by Mitsubishi) provides a grade of resolution and stable, saturated colors the likes of which you've never seen on your home television set. At $6,995, it should!

For reasons we shall soon see, the SDI subsystem benefits greatly if the computer it is attached to is equipped with a brace of special two-port memory boards. These boards plug right into the S-100 bus also, and become the area wherein the picture is stored while it is being displayed.

"Two port" means that in addition to the normal connection that exists between the memory and CPU, there exists an additional direct link between the memory and SDI and DMA Board. This allows the SDI to refresh the image on the screen without having to compete with the CPU for time on the "normal" S-100 bus.

The two-port memory is currently available as a $795 16-kilobyte static product, large enough for one low-resolution picture or one-third of a medium- or high-resolution one. There is no reason, however, that two-port memories cannot follow the same trend towards higher density (more kilobytes per board) and lower cost, as we have seen in other memory products.

REMEMBER THAT PICTURE

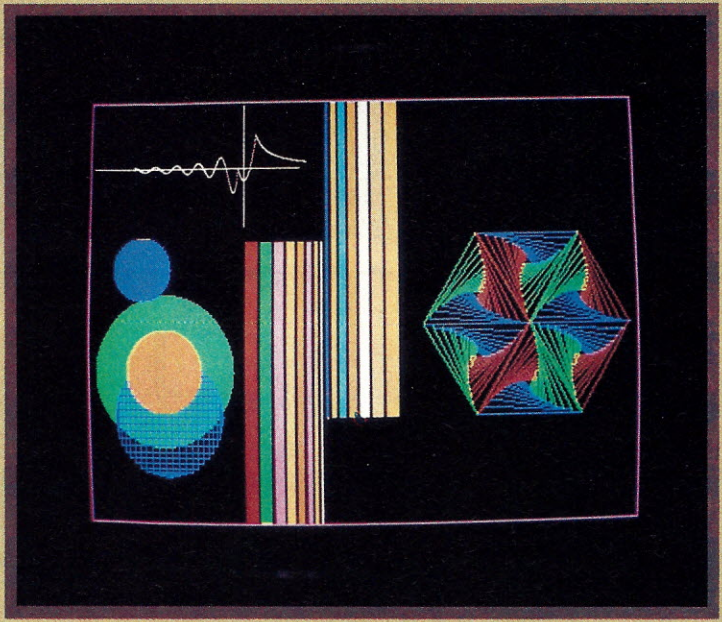
With few exceptions, a television tube will retain an image on its screen for only a fraction of a second. After that, everything goes black. Such a feature is, of course, necessary in order to show "moving" pictures, but it means that

every detail of a picture must be remembered somewhere else in the system if the screen is to show a steady, unmoving image. The "somewhere else" in this case is either a portion of the computer's normal Random-Access Memory (RAM) or the special two-port RAM described above.

To display a stationary image, the SDI electronics continuously interrogate the contents of the RAM and re-write the picture to the screen. This is done 30 times each second, the same rate as an ordinary TV set. Since the human eye cannot detect such a rapid flicker, the image appears to be standing still.

Your eyes have a marvelous capacity for viewing a complex image and delivering meaningful information to the brain. Systems such as the SDI take advantage of this fact by forming pictures that are rich in detail. The price that must be paid is that this detail must be retained in the RAM. That means that a large chunk of memory must be dedicated to remembering the contents of the image.

The designers of the SDI have taken a direct approach to this problem, allocating a portion of the memory to each tiny area of the screen. The smallest viewable area is called a pixel (for "picture element"). Each of the 22,869, 91,476 or 365,904 pixels in a single image (depending upon the chosen resolution) is represented either by a bit or a nybble in memory, depending upon whether the image is black-and-white or color. (A nybble is four bits of memory — one half of a byte.)



There is a direct trade-off between picture resolution and memory requirements. Twelve kilobytes of memory can hold either a low-resolution color picture or a medium-resolution black and white one. Forty-eight kilobytes will retain a medium-resolution color picture or a high-resolution monochrome one. Table 1 shows the options. The user of the system is not restricted by the nomenclature. "Color" can be any 16 colors, including 16 shades of grey or tan, and "black-and-white" can be replaced with blue-and-yellow or red-and-pink, or whatever combination you desire.

The most common arrangement is to dedicate a 48-kilobyte chunk of memory to the function of holding either a single medium- or high-resolution picture or four low- or medium-resolution ones. Unless the two-port RAM is utilized, the operating system and any user programs have to be limited to the first 16 kilobytes of memory. This restriction can be alleviated by using Cromemco's proven memory-mapping scheme, which allows several banks of 64-kilobyte memory to be contained in the computer.

If the two-port RAMs are specified, they can be allocated to the higher memory banks. The system we saw had three 48-kilobyte banks of memory for picture retention in addition to 64 kilobytes of normal computer RAM.

THE CONTENDERS

The DMA board of the SDI interrogates the picture memory by the use of a Direct Memory Accessing method. This technique, sometimes called "cycle stealing," allows the DMA Board to take priority over the CPU for the purpose of looking at a memory location.

Because of the vast number of such accesses that are needed in this application, the CPU is robbed of its time to a noticeable extent. In fact, the simple task of displaying a low-resolution picture can take up to 45% of a memory's available time, reducing the CPU's efficiency to 65% of its full-strength value. A high-resolution picture takes a crippling 95% of the CPU's capacity away.

That might sound like a serious problem, but consider that SDI subsystems are most likely to be used in computers that are dedicated to graphics applications, and this restriction may be an acceptable one. Even 5% of a Z-80 is still a pretty powerful tool.

Cromemco is concerned enough, however, to offer several ways around the problem. Two of them are simple: tell the SDI that you want to trim 12.5% off the top and bottom of the picture and/or reduce the vertical resolution by half, and the CPU is given back up to 70% of its oats. Add the two-port RAMs, and the problem goes away almost entirely. This is due to the fact that the DMA accesses to the picture memory take place over separate cables, freeing the S-100 bus to the nearly exclusive use of the CPU.

A MAP IN COLOR

Representing each spot on the screen by a piece of RAM is a straightforward plan, but Cromemco has enhanced the idea with a simple but powerful technique: color mapping. The SDI contains a small extra area of memory designated the Color Mapping RAM. It is equivalent to only 24 bytes of regular memory, but it contains the secret of many of the more spectacular attributes of the SDI images.

The Color Mapping RAM is organized as shown in Figure 3. Each of the 48 cells can contain a numeric value from 0 to 15, representing the power with which the red, green or blue electron gun of the color tube bombards the cathode screen. Each of the 16 triplets of such intensities is a "color value." It is this value which is actually retained by the larger (12K or 48K) picture RAM.

In the partially completed color map shown in Figure 1, a nybble containing the value 0 would cause its corresponding pixel to be displayed in black (all guns off). White (all guns turned to full intensity) is represented by a value of 15. A few other simple examples are shown. An incredible 4,096 different shades of color are possible, although only 16 can be utilized for any given image.

For monochrome images, each pixel is represented by one bit in the picture memory area. If the bit is a '0,' the color value of 0 in Figure 3 is sent to the tube. A '1' bit causes a color value of 15 to be sent.

By retaining a given image on the screen and varying the values of electron gun intensity in the color map, the hue and warmth of the picture can be instantly altered, subtly or radically. False-color images, such as those received from crop-mapping satellites, can be made in this manner. Cromemco programmers have come up with demonstration programs that play with the Color Mapping RAM to produce some mind-boggling dynamic displays.

Taking advantage of the speed with which the color map can be altered — thousands of times each second — the im-

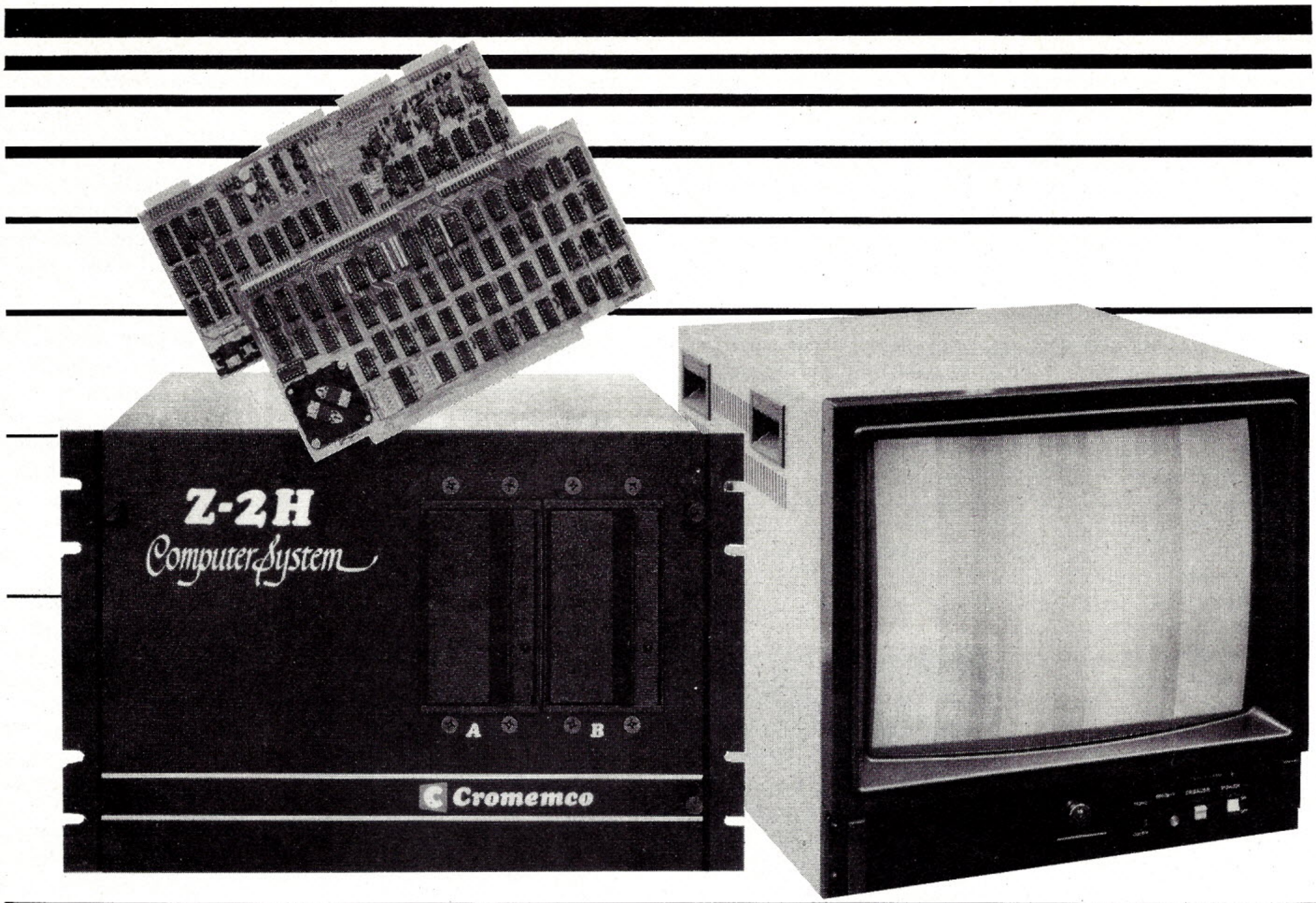


Table 1. SDI Picture Resolution Options

	Size of Picture Memory (bytes)	
	Color	Monochrome
12K	189 x 121 pixels	378 x 242 pixels
48K	378 x 242 pixels	756 x 484 pixels

The highest resolution exceeds that of most television picture tubes.

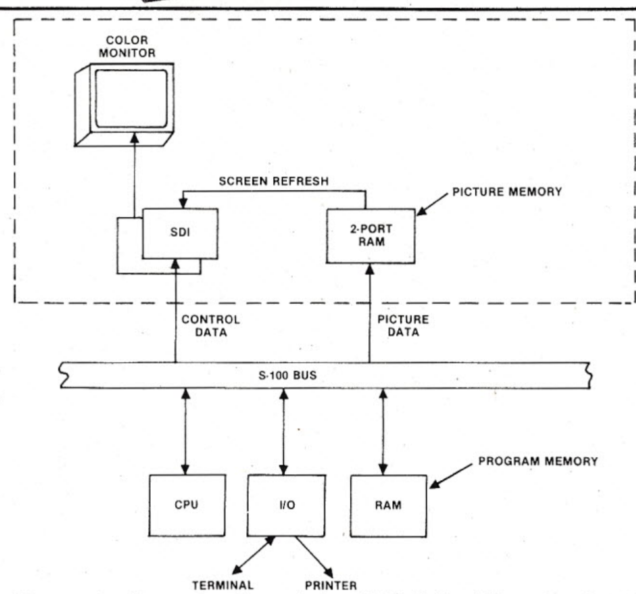


Figure 1. SDI Subsystem, with special 2-port memory connected.

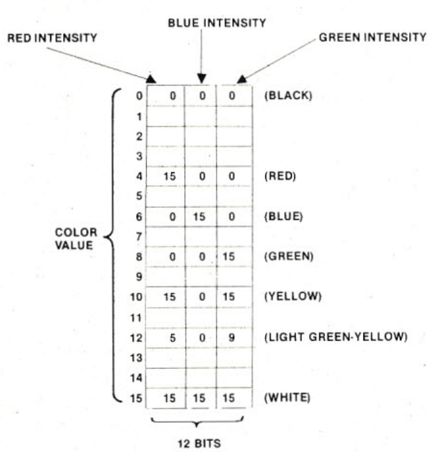


Figure 3. Organization of the SDI Color Mapping RAM

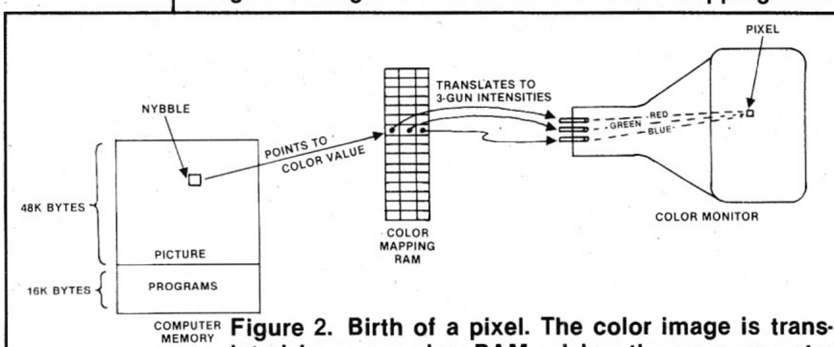


Figure 2. Birth of a pixel. The color image is translated by a mapping RAM, giving the user an extra dimension of control.

age can appear as if it were illuminated by a spinning color wheel or rapidly moving light source. Given enough imagination and an SDI, the television industry could create TV commercials that would defy you to take your eyes away from the product being shown.

MAKING PICTURES

Images are created when the CPU writes information into the picture area of the computer RAM. In addition, there are five control ports to the SDI that must be managed by the CPU. The rules to utilize when doing this are relatively simple, and a programmer with average skills could be drawing pictures the first day. The SDI User's Guide gives several program examples in Z-80 Assembler and FORTRAN, and the principles can be applied to BASIC and other languages as well.

Soon, the manufacturer will release extensive FORTRAN subroutines that can be called from user's programs. One of the more useful ones will plot any two-variable functions, automatically providing the X and Y axes and scaling the image to fit into a defined space. Other routines ensure that circles and disks come out round when drawn. In time, you can expect to see a simple statistical analysis package, programs for factor analysis and routines for drawing high-resolution characters in various type styles.

Once an image is created, it can be permanently stored in two ways. The program that was written to create the picture can be saved on a disk, floppy diskette or cassette and executed again to re-generate the picture. In addition, the 12 or 48 kilobytes of RAM that represent the raw image can be saved as is onto any of these magnetic media.

The computer we tested was a Cromemco System Three equipped with standard-size floppy disk drives; five 48-kilobyte images could be stored on each single-density surface of the diskettes. It takes about 15 seconds to read or write an image using this method of archiving. Work is in progress on a compaction program which will increase the storage capacity by a factor of four.

OTHER TRICKS

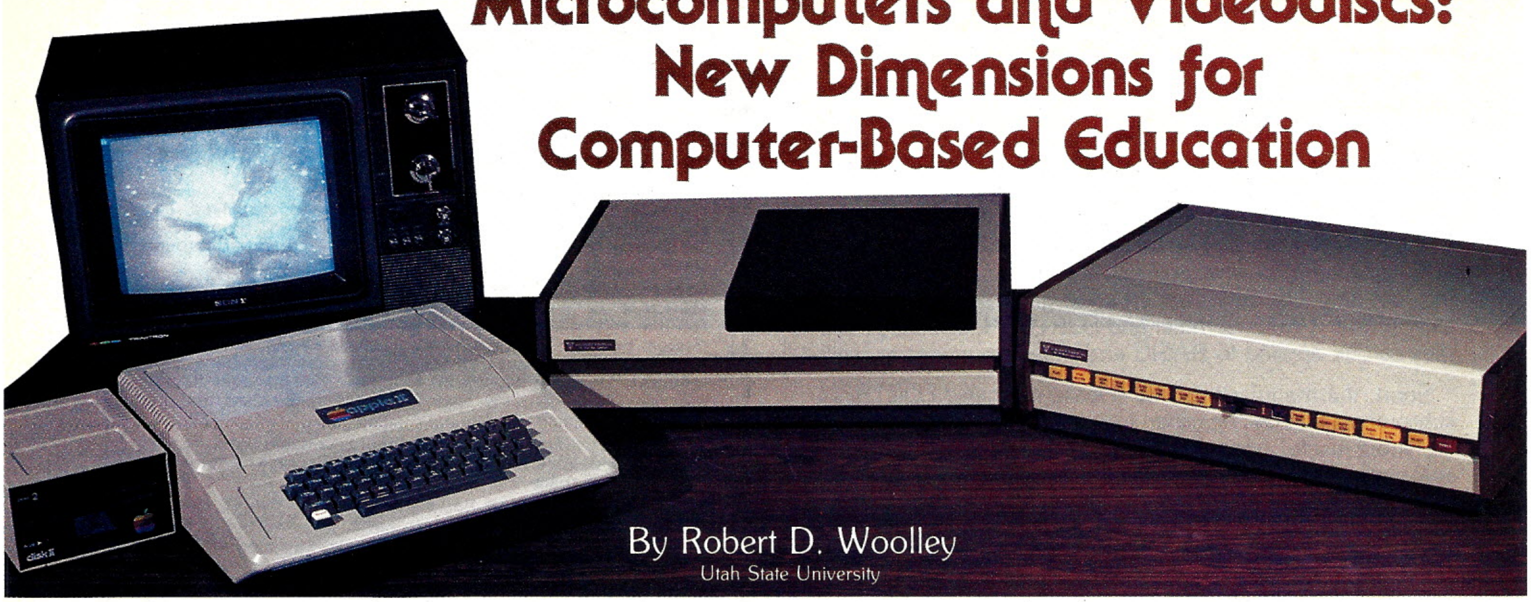
The SDI has the capability for displaying high- and low-resolution pictures, in a mix of color and monochrome, all on the same screen. Images can be lifted from previously-generated pictures and reduced or expanded in size and added to an existing image. Windows in any shape can be opened on an image to reveal a portion of another image that is stored in a separate bank of memory. Pictures can be "hidden" in other images and faded into existence by controlling the Color Mapping RAM.

There is already talk in Cromemco's back rooms about additions to their graphics "family": cards for character generation, cards for rotating and zooming images, software for three-dimensional representation, and on and on. It's apparent that Cromemco is committed to the development of graphics products to an extent far exceeding that of their earlier TV Dazzler boards.

In all, the SDI color graphics subsystem presents a breakthrough in capabilities that have previously been available only in far more expensive computers. It is an exciting, well-designed solution in search of someone's tough problem — maybe yours.

If it is, don't be disappointed if you can't see right away how your situation can be helped with graphics displays of this type. We are all somewhat limited in our minds to solving problems with the tools we have grown up with. When a new one comes along, it's seldom obvious just where it fits in. That's how business computers started out, and look where they are now. You can bet that, given time, you will wonder what you did before high-resolution color graphics became commonplace.☐

Microcomputers and Videodiscs: New Dimensions for Computer-Based Education



By Robert D. Woolley
Utah State University

Videodiscs are beginning to enter the home entertainment market, offering an alternative for those who have been thinking of purchasing home video cassette units. Scientific uses of this new method of disc storage are being explored.

One such program is taking place at Utah State University, where specialists are using a videodisc system coupled with a microcomputer to create teaching programs that can offer extremely high quality video graphics.

The computer programming can be put onto the disc along with any type of graphics, extending the capabilities of the disc and the computer. For example, an educational videodisc program could combine narration by noted personalities like the Muppets or Walter Cronkite with the software for a math or history lesson. Similar work is being done with video cassettes, but at this time it appears that videodiscs will offer a cheaper alternative.

The Videodisc Innovations Project at Utah State University has placed primary emphasis on evaluating the educational and training applications of videodisc technology. Research has utilized the MCA Educational/Industrial player which is an optical/reflective disc system. Computer-based education in combination with videodisc has been an area of emphasis. At the present time, projects are underway in the areas of library instruction, teaching the mentally handicapped, and the implementation of a basic university physics curriculum using intelligent videodisc. The physics project is in cooperation with the University of Utah.

A videodisc is a high density carrier of audio and visual information. This data can be displayed in any combination of sound, pictures or other data on a standard television receiver, monitor or video projector. The disc, illustrated in Photo 2, is 12 inches (30 cm) in diameter, one tenth (2.5 mm) of an inch thick and weighs an average of 6.3 ounces (180 grams).

Information is recorded on the disc using master source materials, using videotape or film, in real time. Each side of the disc has 54,000 separate frames or screens of information, which are encoded with a unique number. A single television frame is generated by each complete rotation of the disc. These separate frame numbers make it possible to independently retrieve any frame on the disc. In ordinary linear play mode it is possible to have 30 minutes of motion on each side of the disc. In extended play or constant linear velocity, one hour per side is possible.

Information on the disc is recorded on a spiral track using laser technology. Because lasers are needed, the recording devices are much more expensive than the units. The surface of the disk is lined with micropits representing an on or off conditional state. These pits are the information corners of the videodisc. A microphotograph of the surface of the disc appears in Photo 3.

The disc is read using a low powered laser which alternately blocks or passes the information carried on the disc. The interrupts in the light beam, see Photo 4, are then translated into electronic impulses to yield a clear picture on a television screen.

The MCA Videodisc System offers a variety of impressive features such as dual audio channels, stop motion, frame by frame review, variable slow motion, auto stop, rapid scan, and most importantly, direct random access to any frame on the disc in 2.5 seconds. A full search from beginning to end can be done in five seconds.

PHOTO 2 MCA Optical Videodisc

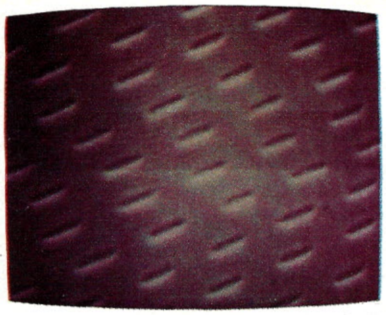


PHOTO 3
Microphotograph of the surface of a videodisc.

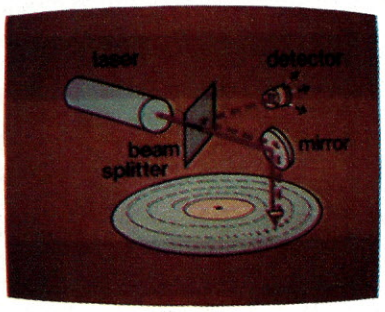


PHOTO 4
Laser read system employed by the MCA videodisc.

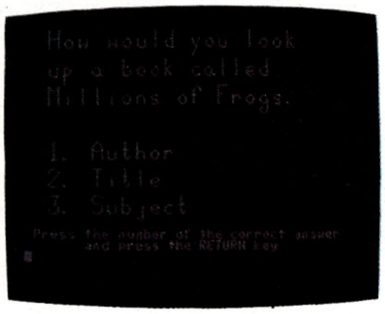


PHOTO 5
Question with videodisc audio "This is going to be tricky." Note the use of multiple character sets.

PHOTO 6
Correct reinforcement: Two to three seconds of clapping frogs.

PHOTO 7
Negative response: Motion sequence from a puppet with audio "No, no, that's not right."

In terms of digital storage, a single side of an optical disc will store between 10^{10} and 10^{11} bits of data. This equates to about 60 billion bits or 7.5 billion bytes of storage. The storage density is so great that if the track area unraveled as a ribbon of data, it would be 21 miles in length on a single side. The present state of the art of commercially available systems has yielded read only systems. Unlike video cassettes, discs cannot be rerecorded at will. Therefore, a great deal of careful preparation of source material must be made before a disc is finally mastered.

The videodisc player shown in Photo 1 is also programmable for short programming applications. Programs can be read directly from the disc or can be entered manually using a hand held controller. For purposes of computer-based education the player is equipped with a TTC compatible interface so an external computer can be used as a controller.

A number of different microcomputers, including the IMSAI, Radio Shack, and Apple II, have been interfaced to the videodisc player. The Apple II has been the most effective because of its portability, color capability, user definable characters, and the overall ease with which it can be interfaced to peripheral equipment.

Table 1. Syntax and Commands used with the Apple II Interface.

Command Syntax	Function
REJ	Reject. Discontinues any play function and returns the disc to park position.
STOP	Stops motion on a single frame (freeze-frame).
PLAY	Initiates playing of a disc and causes the disc to play in a linear mode after any other command.
SCAN FWD	Scan forward, or fast forward.
SCAN REV	Scan reverse or fast reverse.
STEP FWD	Step Forward. Plays forward one frame at a time.
STEP REV	Step reverse. Plays backward one frame at a time.
SLOW FWD	Slow forward. Slow-motion forward at a predetermined rate.
SLOW REV	Slow reverse. Slow-motion backward at a predetermined rate.
AUD 1	Audio Track #1. Command used to turn track on or off.
AUD 2	Audio Track #2. Same function for second audio track.
FRM DSP	Frame display. Displays the frame number on the video screen.
SRCH	Search. Causes automatic search for a specified frame number.
AUTO STOP	Automatic stop. Causes a program to end at a specified frame number.
0-9	Digits for entry of frame numbers, recalling memory registers, and program line numbers.
RCL	Recall. Allows inspection of memory registers in the videodisc.
STO	Store. Allows specific frame numbers to be stored in the videodisc microprocessor at a specified register address.
CLR	Clear. Clears a frame number from a memory register.
PGM	Program. Causes the videodisc to enter a write program mode.
END	Causes termination of the program mode.
RUN	Executes a predefined user program.
DEC REG	Decrement Register. Will subtract one from the content of a register for a specified number of operations.
INPUT	Causes machine to wait for a user, and permits branching to a predetermined program subroutine.
HALT	Stops program execution.
APPLE	Switches from videodisc video to computer generated video.
VDISC	Switches from computer generated video to videodisc video.

The interface presently in use with a 48K Apple II microcomputer was laid out on a single Apple prototyping card. The logic of the interface is such that it could easily be used to control any type of NTSC video playback equipment. Twenty-six user commands are available, as shown in Table 1.

Both the videodisc and the computer display appear on a single screen, but not simultaneously. Hence, video-switching is possible but video overlay has not been achieved as yet. The videodisc signal is taken directly to the Apple II and displayed or not displayed according to program requirements.

Software programming has been implemented in BASIC and in an extended version of common PILOT. Since it is possible to put any type of video image on a videodisc, some powerful video graphic display options become possible within a computer-based educational sequence. Segments with TV personalities can be recorded and spliced in with computer programs to give the lesson a sophisticated yet personal approach. Under computer control, it is also possible to use computer generated video with videodisc generated audio which yields a complete random access audio system as well.

To demonstrate some of the capabilities of the system, a short program on using school media centers was developed. Photos 5 through 8 illustrate specific frames from the program where the computer and the videodisc are used together. The purpose of the "Media Center" program was to work with children on a second to fourth grade level and teach them how to find things in a library. The program is still in development and testing stages.

Because the nature of the program content requires a good deal of text, audio reinforcers from the videodisc were used to add interest and personalize the program. All of the audio and video sequences are set up as callable subroutines within any given program segment so use of the videodisc within the program is very simple. The program is written in integer BASIC but with essentially a PILOT-like structure.

The videodisc appears to be a medium with incredible flexibility for educational use.

Photos 9 through 12 represent a series of motion sequences where a touch panel was used with the microcomputer videodisc system. In this instance, the touch panel interface and the videodisc interface reside on the same prototyping and within the Apple II. The software is the "Matching Sizes, Shapes, and Colors Program," developed by the Exceptional Child Center at Utah State University. This program has been field tested and validated.

The purpose of the instruction is to teach the child to match objects that are like in size, color, or shape. For example, match white circles with white circles, or select the large square from a display of squares.

Short filmed sequences are displayed as reinforcers with variation in length of feedback and intensity of reward or punishment. Since these responses can be accessed by any user, some of the video sequences and some of the audio were also used with the "Media Center" program even though they were not originally designed for this purpose.

When the system is operating in a linear manner, the videodisc searches for the next sequence to be displayed while the learner uses the text generated by the computer. If branching is conditional upon the learner's response, the videodisc searches for the appropriate sequence following the response. The maximum delay time incurred to date has been about two seconds. With the microcomputer controlling the

PHOTO 8
Correct reinforcement with audio, "That was very good, you are doing very well."

PHOTO 9
Motion sequence with audio "Watch my friend touch this."

PHOTO 10
Motion with audio "Now you touch this." Color discrimination on the same shape.

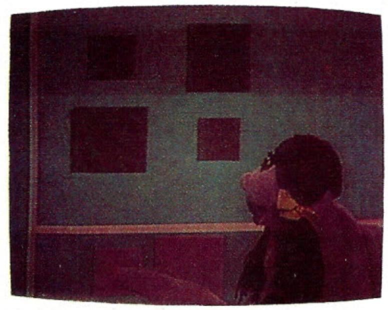


PHOTO 11
Motion sequence with audio "Now you touch the same as this." Size discrimination without color cue.

PHOTO 12
Motion and audio "No, that's not right, touch the screen. Try again!" Remediation sequence.

videodisc, it is possible to use computer management of instruction (CMI) software for testing and validation purposes. This allows the developer a powerful tool for judging student response to the software package.

One thing that became evident with the production of USU Videodisc #1 was the need for an extensive array of graphically oriented reinforcement routines. The routines originally included for use with the "Matching Shapes" program have proven to be very useful for slow learners and small children, but a broader range would have been helpful had we anticipated their utility. Because the videodisc offers virtually distortion-free audio, inflection can be varied almost infinitely to achieve varying degrees of reward. Multilingual feedback responses would also be a useful addition and should be considered when planning a disc.

The videodisc appears to be a medium with incredible flexibility for instructional purposes. It can very easily assume an omnibus quality since virtually all common audio visual formats can be packaged together on a single disc. The cost per frame of content using ordinary video production techniques would appear to be much less expensive than trying to generate total program content utilizing computer graphics alone.

ISSUES AND FUTURES

Present recording with the MCA, Thompson and Magnavox systems uses video recording technology to create a read only optical disc. In November, 1978, Philips Data Systems announced the direct read after write (DRAW) system with an information capacity of 10^{10} bits per disc or over 500,000 typewritten pages. This system features random access with any address accessible within 250 microseconds. In effect, this allows instant access to 5 billion bits of data per side of each disc. The recording system has been reported to be virtually error free.

Assuming that this technology becomes widely available within the next few years, it could have an enormous impact on existing magnetic storage technologies. RCA has also announced its own ablative optical disc system with a storage capacity of 10^{11} bits per disc or approximately 12.5 billion bytes per disc.

Obviously the market will be moving rapidly in the direction of digital audio and digital video, which should yield heretofore unimagined possibilities for computer graphics and computer-based education. Hopefully, many of our old computer graphics and audio constraints will begin to disappear.

Present costs of the read/write systems are not well enough known to warrant publication. If the MCA price release for the industrial player at $5,000 per unit, and the Magnavox/Philips home entertainment player at $775 is any kind of guide, the consumer should expect some vigorous and competitively priced equipment in the near future. In terms of storage cost for data, the optical disc yields a cost of about 5×10^{-8} cents per bit with an estimated archival life of 10 years. Magnetic disc media such as the IBM 3340 yield a cost of about 5×10^{-4} cents per bit with an estimated life of two to three years.

These types of cost comparisons could easily be extended. The point is simple. Optical disc technology appears to be a viable competitor for all projected mass storage media both in terms of upper boundary limits of storage and user cost per bit. Both hardware and media costs appear to be competitive with, and less expensive than, existing technologies.

One of the advantages of computer-based education with a microcomputer videodisc system is simply that it is not technologically clumsy. Most early efforts at integrating computers with "media" have not been effective because of their overall complexity. Some of the best implementations have been on

large scale systems like PLATO, but even these have been technologically limited to particular kinds of media.

The videodisc holds out another promise that we can probably consider fulfilled. It makes available to an unlimited audience portions of a complex instructional process that would have been available only to the few who could afford it. This in and of itself is probably one of the most encouraging things about the technology.

Even with all the positive features, many questions remain which need to be answered.

1. Can videodiscs be cost effective in low volume, limited application markets?
2. What are the implications to an instructional designer when using both videodisc and computer technology? Have all the stops been pulled or have we simply made a complex design problem even more complex by adding increased capability?
3. Is standardization going to become a major area of concern? Will there be a real consumer battle between the optical reflective, optical transmissive, and capacitance disc systems?
4. How soon can we expect to see meaningful software development aside from repackaged films and television programs available on videodisc?
5. Will our enhanced ability to saturate a learner with all types of media improve the past performance record of computer-based education or will we merely effect an improvement in attitude with little corresponding improvement in learning?
6. Will the direct read after write discs offer any capacity for large scale replication once meaningful courseware has been developed?
7. Will the television industry adjust and provide receivers capable of handling the enhanced graphics capabilities of videodisc and computer technology at reasonable cost?

In summary, microcomputer videodisc systems offer computer-based education (1) rapid random access, (2) audio capability including multilingual capacity, (3) high software and equipment reliability, (4) portability and exportability of software at relatively low cost, (5) complete video graphics ranging from slow motion effects, and motion sequences, to whatever a display device can efficiently handle and in any color required.

Original development of instructional software will always be a time consuming and expensive process when it is done carefully. Neither the microcomputer nor videodisc offer any real solutions to this problem. What they do offer, both singly and together, are highly interactive mediums for instruction where software can be made widely available at very low costs. Given these kinds of considerations, the future of microcomputer videodisc systems is likely to receive some major development efforts and should be a promising technology for education and training applications.☐

ABOUT THE AUTHOR

Robert D. Woolley directs the Curriculum Materials Center of the Utah State University Merrill Library and Learning Resources Program. He is an instructional development specialist with the University's Instructional Development Division, and an Assistant Professor with the Instructional Media Department.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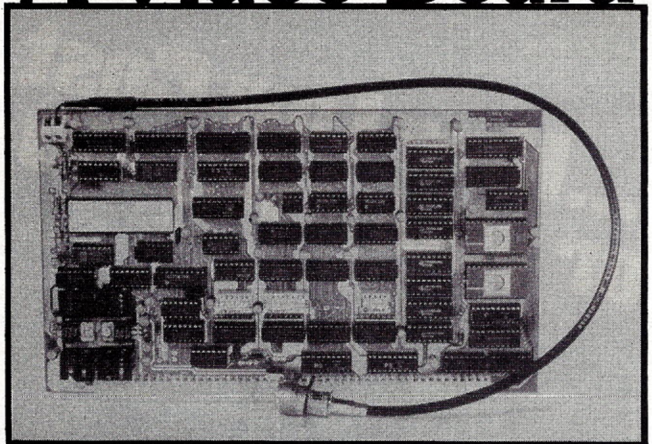
A Video Board



for 6800 Systems

By Bill Turner, Senior Editor Southeast Region

Nearly everyone who uses a computer has just about the same concern: high quality video display. This is an important feature since just about all micro-based systems use some type of Cathode Ray Tube display system, either as an outboard intelligent or dumb terminal.

Owners of S-100 bus type systems were able to obtain memory mapped video interfaces for their systems early in the game. Unfortunately, those who chose the Motorola 6800-based systems were not as lucky.

However, the situation has changed quite dramatically with the introduction of the Gimix 24x80 video board for the standard SS-50 6800 bus, with primary design being around the version 3.0 of the Gimix bug monitor.

The video board can also be used with either MIKBUG or SWTBUG PROMs by using special driver packages. The software packages for use with these monitors are provided by Gimix as part of the board package. Due to the general flexibility of the board, users can develop their own drivers to handle specific applications.

Part of the flexibility of the board includes the pre-defining of specific character sets, and loading them into the character generator RAM. This gives users an unusual flexibility in application design.

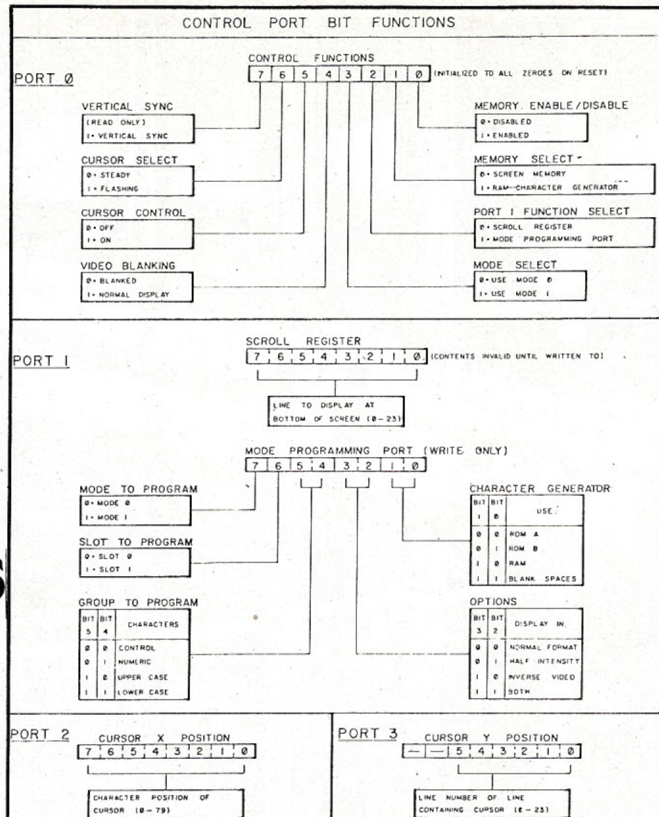
BOARD DESCRIPTION

The board is designed to be plugged into any standard SS-50 pin data bus. The board occupies a 2K block of CPU address space; starting at any 2K boundary. The Gimix standard address is F000 HEX. However, onboard dip switches, shown in Photo 1, allow you to change this address as necessary. Users of SWTBUG will want to change the address, since the PROM occupies the E000 to F000 HEX address range. For my system I found that D000 HEX was an ideal location.

The board only requires one external connection via a coax cable to the remote CRT monitor. The Gimix board is not recommended for use with a modified television set. This is because the 80 character line requires a 5 to 7 MHz bandwidth for proper display. I did find that when used with a Concord or Sanyo monitor, the display was well within acceptable limits.

The board requires four bytes of RAM memory for use as control ports. These locations can be on any 4-byte boundary. Gimix uses F900 HEX as their standard. They are selectable by onboard dip switches.

The functions of these ports and their mapping are shown in Figure 1. Notice that the ports are numbered 0 to 3 and are used to control the cursor positions and scrolling features of the board.



Courtesy of Gimix

Figure 1. 80x24 Video Board-Control Port Map.

PROGRAMMING THE BOARD

The Gimix video board is 'ghostable,' meaning that it can be disconnected from the memory bus, which makes the programming of it fairly simple. The programming merely involves enabling the screen memory, setting the scroll register (port 1) to zero, and defining the mode programming port, all of which are clearly defined in the owner's manual which comes with the board.

The board is capable of operating in two different modes, 0 and 1. A mode is a set of commands that tells the board

MODE PROGRAMMING WORKSHEET

MODE	MOST SIGNIFICANT BITS OF CHARACTERS IN SCREEN MEMORY: SLOT (BIT 7)	CHARACTER GROUP (BIT 6)	(BIT 5)	CHARACTER TYPE	INVERSE VIDEO? Ø = NO 1 = YES	HALF INTENSITY? Ø = NO 1 = YES	WHICH CHARACTER GENERATOR? ØØ = ROM A, 1Ø = RAM Ø1 = ROM B, 11 = BLANK		HEX VALUE TO WRITE TO PORT 1 *
Ø	Ø	Ø	Ø	SLOT Ø CONTROL					Ø
	Ø	Ø	1	SLOT Ø NUMERIC					1
	Ø	1	Ø	SLOT Ø UPPER CASE					2
	Ø	1	1	SLOT Ø LOWER CASE					3
	1	Ø	Ø	SLOT 1 CONTROL					4
	1	Ø	1	SLOT 1 NUMERIC					5
	1	1	Ø	SLOT 1 UPPER CASE					6
	1	1	1	SLOT 1 LOWER CASE					7
1	Ø	Ø	Ø	SLOT Ø CONTROL					8
	Ø	Ø	1	SLOT Ø NUMERIC					9
	Ø	1	Ø	SLOT Ø UPPER CASE					A
	Ø	1	1	SLOT Ø LOWER CASE					B
	1	Ø	Ø	SLOT 1 CONTROL					C
	1	Ø	1	SLOT 1 NUMERIC					D
	1	1	Ø	SLOT 1 UPPER CASE					E
	1	1	1	SLOT 1 LOWER CASE					F

LEFT HEX - DIGIT

RIGHT HEX - DIGIT

* PORT Ø BIT 2 MUST BE SET TO 1 IN ORDER FOR PORT 1 TO FUNCTION AS THE MODE PROGRAMMING PORT.

Figure 2. Video Board Mode Work Sheet. Courtesy of Gimix

how to display characters contained in the screen memory. Each of these commands is a single byte and the high order 4 bits are used to define which of the 16 possible character groups is being programmed. This mode programming function is shown in Figure 2.

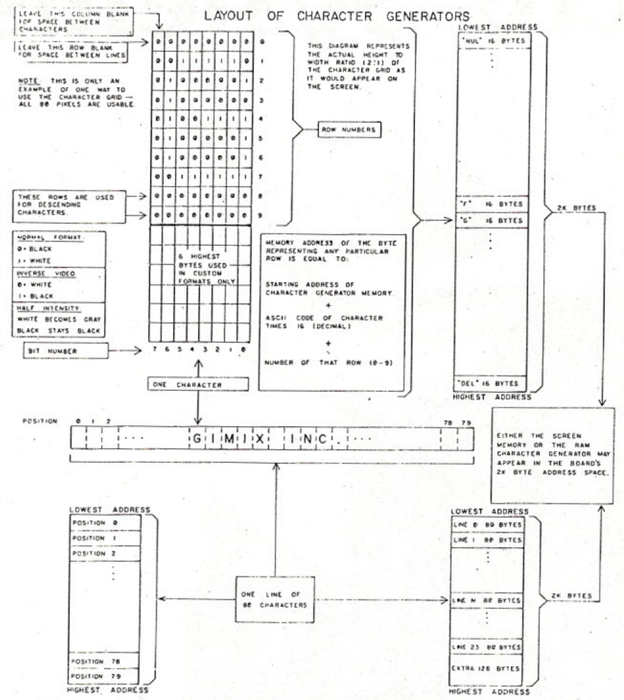


Figure 3. Layout of Screen Memory. Courtesy of Gimix

CHARACTER GENERATORS

The Gimix board has three on board character generators, each containing patterns for 128 characters. A fourth generator produces only blank spaces. A two-bit code is used to define which character generator is to be used.

The fourth blank space character generator is supplied on the board so that certain character sets can be loaded into the display screen memory to be displayed as blanks. This makes it possible to design screen formats that require security sensitive information such as passwords that must not be displayable.

Figure 3 represents the layout of the different character generators and the memory address space required, along with the different character functions. From the figure you can see that each character generator is 2K bytes memory. This is further subdivided into 128 segments, with each segment containing the display pattern for a single character. Each segment is 16 bytes long, which is sufficient to store an 8 by 16 character pattern. For the standard 80 x 24 version of the monitor, the character grid size is 8 x 10, with the last 6 bytes of each segment being unused.

Due to the design of the character generator system on the Gimix board, everything from graphics to fill-in formats can be programmed by the user. The graphics generated by the board are sufficient for most programming activities even though it wasn't designed as a graphics system in the normal sense.

IDEAS AND APPLICATIONS

With all the flexibility built into this board, the hardware and software designer types will be able to find numerous uses to put the board to work on. One of the most exciting and one that will be finding use on my system is in timesharing.

When used in a timesharing mode or electronic mailbox, the screen can be disabled so that unwanted updates cannot happen until the user is ready. Also, the 2K used by the RAM character generator can be used as a scratch pad so messages can be written and edited before transmitting them to the remote receiver. ☐

Industrial Micro Systems

Series 8000

By Tom Fox, Systems Editor

It's probably a terrible thing to say about today's computer industry, but the time has come when many of us have ceased to be amazed at the marvelous power built into 8080- and Z-80-based systems. The army of designers and implementors who have been responsible for the creation of these integrated circuit "chips" have every right to feel slighted by that statement; but the fact is they have done their jobs so well that the tremendous capabilities built into these 8-bit processors have put them into the "Ho hum. . .so what else is new?" category.

The fact remains, however, that the 8080 and Z-80 families of microprocessors are so good that they have formed the basis for a great many small business computers. This makes it hard for prospective purchasers to choose between competing systems.

Sometimes prospective computer purchasers have to look beyond the basic capabilities of the processing "engine" in a computer to find a good one. In some cases, getting to know the company that manufactures the product helps. This month, we'll take a look at a machine that is more unique in its origin than in its native capabilities.

Industrial Micro Systems is one of the few manufacturers in the small computer business which was not founded for the purpose of making this type of product. In 1976, the legendary rise in popularity of S-100-based "hobby" computers found Industrial Micro Systems as an established supplier of electronic process equipment to control integrated circuit fabrication at the microscopic level.

Having organized the people, facilities and expertise needed to design and build industrial-grade equipment, they turned their hand to their first consumer product: an 8K static Random-Access Memory (RAM) board for the S-100 bus. This was soon followed by similar 16K and 32K units, an 8080 CPU board, terminal and floppy disk interface boards and metal enclosures for disk drives and entire microcomputers. It finally became possible to assemble a computer system almost exclusively with Industrial Micro Systems components; in fact, there are several "private label" systems on the market that share this very origin.

It was nearly inevitable, then, that the world would soon see a microcomputer system sporting an Industrial Micro name tag. There are, in fact, two such systems: the Series 5000, supplied with one, two or three 5-inch minifloppy disk drives, and the Series 8000, built around an equal number of full-size 8-inch drives. The two systems are otherwise similar in most respects, so we'll investigate the Series 8000 in detail.

HARDWARE

The computer is built around a 12-slot (optionally, 21-slot) S-100 motherboard, which features passive terminating networks to tame the galloping surge of electrical signals as they rush from board to board and back again. Into the motherboard are plugged a Central Processing Unit (CPU), Random-Access Memory (RAM), floppy disk controller, and terminal interfaces.

You can choose from two CPU boards. There is an 8080A-based version available which includes two serial RS-232 input/output ports for connection to a CRT terminal and printer. A better choice, we feel, would be the optional Z-80 CPU which operates at twice the speed: four megaHertz. The Z-80 CPU does require that a separate interface card be included in the package, however. This board handles two serial terminal devices and contains a separate parallel port for connection to such things as burglar alarms or process control transducers.

Electronic memory is in the form of 16K or 32K RAM cards, the very ones which established Industrial Micro Systems in the small computer market. Over 800 of these boards have been built each month for some time now, so you shouldn't expect to see any design errors. Although you can purchase a Series 8000 with as little as 16 kilobytes of memory, we would fill it up with a full 64 kilobytes before we took delivery on the machine. It's disheartening to think of how many programmer-centuries have been wasted in trying to make perfectly good software run in a too-small memory space.

Both of the RAM cards, incidentally, feature "bank select" memory mapping control. This feature, utilized by Cromemco, Alpha Micro Systems and others, allows over 500 kilobytes of memory to be connected in a single system. The feature is not really useful other than in a multi-tasking environment, though, and the standard catalog of Series 8000 software does not yet include an operating system that takes advantage of this extendable memory feature.

The S-100 mother board includes one final card: the floppy disk controller. This component utilizes the powerful NEC μPD765 multi-function integrated circuit. The controller allows the connection of up to four floppy disk drives, any of which can be single- or double-density or single- or double-sided.

This brings us to the disk drives themselves. The Series 8000 enclosures will house up to three full-size 8-inch floppy disk units. The standard drive is single-sided and is supplied by Shugart. Optionally available is a double-sided version, built by Remex. All disk drives are the double-density IBM format, which means that 500 kilobytes of data can be stored on each diskette surface. That's up to three megabytes of storage on a fully-equipped Series 8000.

The standard series 8000 is supplied in a free standing box which integrates the S-100 electronics, disk drives and power supply. An option that's very useful is a desk which neatly holds all of these parts, and provides a working surface for the CRT terminal and all of the paraphernalia which inevitably collects around a computer system.

Even though everything is nicely tucked away in this computer desk, maintenance access ranks with the best we've seen. A hinged panel at the rear drops down like the tail flap in a pair of long underwear to bare all of the S-100 plug-in cards. If deeper access is needed, tip the hinged desk top up and back, and every detail of the power supply and disk drives is exposed.

All power and data connections are concentrated onto a rear panel which is recessed so that the desk can be pushed tightly up against a wall. This panel incorporates convenience outlets for AC power to the terminal and printer — a nice touch that is often neglected.

A rather alarming detail is that cooling fans for the electronic components are listed as an extra-cost option. They are important, even in the face of assurances that the equipment will run OK with only natural air convection to cool the components. The hotter a computer runs, the quicker it will quit on you — and don't let anyone tell you differently.

A CRT terminal and printer are needed to complete the computer system. IMS does not manufacture or supply these items, leaving that to their dealers. Except for the disk drives, every other component of the Series 8000 is manufactured by IMS. The sheet-metal enclosures, furniture and printed circuit cards are made in their Orange, California facility. The systems themselves are assembled, tested and burned in at their new facility in Carson City, Nevada.

SOFTWARE

Industrial Micro Systems is the first to admit that they do not have an extensive in-house software development laboratory. They claim (with some justification) that many excellent packages are available from other sources: houses that specialize in such things as operating systems for 8080/Z-80 computers and end-user applications programs.

The manufacturer has, however, taken the trouble to exhaustively test some of the better packages on the Series 8000. They have selected four major operating systems, and will supply any of them with the computer upon request. Even though some of the packages are largely well-known and can be used on most other 8080/Z-80 systems, let's review them briefly:

CP/M by Digital Research — If the industry can be said to have a "standard" operating system, this is the one. Many will argue that better systems are available, but CP/M is more than adequate for many needs, and there is no doubt that most purchaseable applications programs are intended to run on CP/M.

This operating system includes dynamic file management capabilities, a fast 8080 assembler, a general-purpose text editor, and a package of debugging routines. On the Series 8000, the most popular adjunct to CP/M is either Microsoft BASIC or CBASIC by Software Systems. Also available is Microsoft's FORTRAN, which includes an assembler for Z-80 programs.

FAMOS by MVT Microcomputer Systems — FAMOS is a multi-user, multi-tasking operating system. It includes a disk file handling system, a macro assembler and debug package for the 8080 or Z-80, text editors and sorting routines. The package also contains a BASIC compiler and (optionally) a new word processing program called WORD-FLOW. Extensive facilities are there to schedule CPU time for up to 20 separate system users, giving each a certain level of security for their various memory areas and data files.

Pascal by UCSD — The Univeristy of California at San Diego has been using a Series 8000 for the development of their Pascal language/operating system. It is to Industrial Micro Systems' credit that they are making this software available to end users.

More than just a computer language, UCSD Pascal takes over the jobs normally handled by a disk file handler, text editor, and compiler/debugger.

MICROCOBOL by CAP-CPP — CAP-CPP is a London-based firm that has developed a COBOL language system for the Digital Equipment PDP-11 series of mini-computers. They have recently adapted it to 8080/Z-80 microcomputers, and it has been thoroughly exercised on the Series 8000. Many, many business programs have been written in COBOL over the past years.

PRICING

A relatively low cost is one of the most attractive features of the Series 8000. A basic system including 32 kilobytes of memory and a pair of floppy disk drives lists for $4,200 in a table-top housing; $4,700 if the desk is included. (Comparable prices for the Series 5000 are $2,770 and $3,200, respectively.) Add $670 to bring the memory capacity up to 64 kilobytes, a CRT terminal and printer, and you have the makings of a complete business computer for well under $8,000. All software is priced separately, and would be the same price if you purchased it with the Series 8000 or directly from the program authors. ☐

A Color Television Interface

Easy — Versatile — Inexpensive

By William Rogers

The contents of this application note will cover many topics concerning the Video Display Generator; generalizing on some, baiting with others and specifying one complete project. First, I'll talk about why a versatile system is easy to build inexpensively. Then I'll turn to the performance abilities of the VDG and then mention two systems on either extreme. Fourth I'll enter into a software section including a demonstrating program, an expandable TV output display program (for an existing terminal) and a cursor program, which is the main software in this article, and is also expandable. Fifth comes the hardware section complete with an operational schematic for an Exorcisor compatible board. Other systems may function with the hardware as long as the proper signals are used.

Two new products built by Motorola help comprise a display interface circuit for the 525 line black and white televisions or the NTSC (National Television Standards Committee) standard color television sets. The Video Display Generator (MC6847), the Color TV Modulator (MC1372), some memory chips and approximately twelve passive discrete components coupled with an MC6800 microprocessor, or any other MPU (Microprocessor Unit) convert the display system into an active and intelligent terminal.

The ease of interconnection becomes apparent when constructing a system. Most pins have definite connections such as the data bus, the address bus, the analog outputs, the power pins, and the clock input. When using an MPU, the data and address buses need three-state buffers between the VDG's buses. The control pins may be hardwired or logically connected in some fashion making the degree of construction difficulty user definable. A pin similar to a memory chip's select allows three stating of the VDG's address bus and therefore accessibility to the display RAM by an MPU. The other three pins would probably not be used by hobbyist or consumer products houses unless an external character generator was required for a more sophisticated system. An example of a higher level system, which will not be discussed in this article, is the display of apparently 6K of RAM when only 1K of RAM exists in the system. The number of chips involved is decreased significantly using the VDG, therefore making a system easier to build.

Chip count also makes a system less expensive. One VDG costs about $19.95, one TV modulator costs about $4.42, eight 2102 1K x 1 RAMs cost approximately $8.00, two QUAD three-state bus transceivers cost about $5.40, and three HEX three-state buffers cost $5.88 which add up to $43.65. Add a few more dollars to that cost for discretes plus miscellaneous TTL for decoding and a complete display interface with alphanumeric, dense graphics and eight-color capability is achieved for less than $50 on a single unit basis. Compared to $250 up to a $580 cost for boards and compared to the functionality of each board this is a substantial savings in a system investment.

Prices given are approximations only.

Versatility? The VDG has it! Depending on how a person views the concept of modes, the VDG has eleven major modes with a total of 27 distinguishable modes including all the variations. If three state is considered as a viable mode then add one more to the total count.

An explanation of some performance abilities will also back up the variability of the VDG. The circuit operates on +5 volts only, therefore keeping system cost down if no other parts require other power supplies. An on-board character generator has 64 ASCII characters and is user definable with a mask change. An External/Internal Horizontal Synchronization and $\overline{\text{Row Preset}}$ signals are provided for the timing of an external character generator. Eight colors: magenta, blue, orange, green, cyan (a light blue color), yellow, red and buff (an off-white looking color) plus black make up the color selection. The color information feeds into the modulator from two chrominance pins R-Y (ϕA) and B-Y (ϕB). The complete video information (synchronization pulses and data) for a black and white television set comes out on the luminance pin (Y). Eight control pins allow hardware or logic selectable modes.

The first major eleven modes is an Alphanumerics mode which can use the internal or external ROM (character generator) in either green or orange color and can use inverse or noninverse video. Inverse and noninverse simply refer to the characters being black on a colored background or colored on a black background. The screen is sectioned off into 32 characters by 16 character rows.

The second mode is Semigraphic-4. This mode has a choice of eight colors or black and is alphanumeric compatible. The compatibility in this case means the SG-4 mode requires the same amount of display RAM (512 bytes) and each byte or character fills up the same amount of display area on the television screen. In other words, an alphanumeric "A" could have that same area cut up into four blocks with any combination of those blocks lit up. The color choice is one color per character or memory location or byte depending on how you care to define the information.

Semigraphics-6 is the third mode and is basically the same as SG-4 except the blocks are cut up into six pieces and a choice of two four color sets must be made with the Color Set Select pin on the VDG.

The next eight modes are referred to as full graphics modes and have increasing density and memory requirements. The memory locations relate to an area on the screen as in all other modes. The next four modes mentioned will allow a choice of two four color sets. A 64 x 64 graphics mode is three horizontal lines by four pictels or dots that the VDG lights up. This mode requires one kilobyte of memory. A 128 x 64 mode uses two dot clocks by three horizontal lines and two kilobytes of memory. A 128 x 96 graphics mode is two dot clocks wide by two horizontal lines high and uses three kilobytes of memory space. A 128 x 192 graphics

mode requires six kilobytes for a two dot clock wide by one horizontal line high display.

The following four modes only turn a pictel on or off and the on portion can be either green or white depending on the voltage applied to the Color Set Select pin. The element sizes have already been given for three of these modes but the memory requirements are different.

The 128 x 64 mode requires one kilobyte of memory. The 128 x 96 mode requires 1.5 kilobytes of memory. The 128 x 192 mode requires three kilobytes of RAM. The final and most dense mode is the 256 x 192 graphics mode and requires six kilobytes of memory. This mode maps the memory one bit for one pictel on the television screen for a total of 49,152 bits. The density of this mode will allow development of your own alphanumerics of special characters and shapes.

For alphanumeric characters of the same size as those in the alphanumeric mode, a 5 x 7 character font, with one blank line horizontally and one blank line vertically between each character, a total of 44 characters per character row can be achieved with a total of 21 character rows. This would give an overall character font of 6 x 8. Refer to Table 1 for a breakdown of the VDG modes.

For further versatility the VDG may be purchased with the non-interlace or interlace mask option, the interlace version costing slightly more. For those unfamiliar with the term interlace, a television has a frame composed of two fields, each 262½ horizontal lines for a total of 525 lines displayed on the screen.

The first field scans from the upper left hand corner to the middle of the bottom line skipping every other line as the electron beam travels downward. The second field scans from the middle of the top line to the end of the bottom line filing in the lines the first field skipped over. The interlace version scans both fields while the non-interlace only scans every other line (basically field one).

A few reasons for the availability of the two versions to customers are: 1) the non-interlace is a steady display which has neither dot crawl nor zipper effect and does not flicker at a 30 Hz rate, but scans at a 60 Hz rate allowing for an almost unperceivable screen refresh; 2) the interlace version fills in between the lines resulting in a "fuller" or more complete looking picture; 3) by separation and synchronization of odd and even fields through some external circuitry, it is possible to overlay two entirely different pictures on the TV screen. An example of this would be to overlay alphanumeric characters at the bottom of the screen on newscasts or any other broadcasts in order for the deaf or hard of hearing to enjoy television programs and announcements.

The other part of the basic display circuitry is the MC1372 Color Television Video Modulator. The chip generates a composite modulated RF video signal for the television set. The modulation of channel 3 or 4 carrier waves is possible as well as the ability to accept a sound carrier.

There are a minimum of parts required to operate this device. It requires only a single 5-volt power supply and has a TTL compatible clock output (one LS-TTL load) which can have an adjustable duty cycle with the addition of a 10K ohm potentiometer on pin 3 between supply and ground. A 50% duty cycle is achieved with no connection on pin 3.

The output pulse is basically a square wave with a frequency of 3.58 MHz which is the same frequency as the chrominance subcarrier oscillator. The output clock pulse is phase shifted for feedback to the chip. The modulator output amplitude and polarity correspond to the voltage difference between the chroma bias or Color Reference pin (pin 6) and the two color pins ϕA and ϕB (pins 7 and 5). The Chroma Modulator Output (pin 8) provides the vectorial sum of ϕA and ϕB which is fed back into the Chrominance Input (pin 10) which then RF modulates the signal. The RF tank which determines the channel or RF oscillator frequency is between pins 13 and 14. The final modulated output is pin 12 and can then be interconnected to a television set.

Table 1. Detailed Description of VDG Modes.

VDG PINS									COLOR			TV SCREEN		VDG DATA BUS	COMMENTS
$\overline{\text{MS}}$	$\overline{\text{A}}$/G	$\overline{\text{A}}$/S	$\overline{\text{INT}}$/EXT	GM2	GM1	GM0	CSS	INV	Character Color	Background	Border	Display Mode	Detail		
1	0	0	0	X	X	X	0 1	0 1 0 1	Green Black Orange Black	Black Green Black Orange	Black Black	32 Characters in columns 16 Characters in rows	8 dots, 12 dots, 7, 5	extra, ASCII code	The ALPHANUMERIC INTERNAL mode uses an internal character generator which contains the following five dot by seven dot characters: @ABCDEFGHIJKLMNOPQRSTUVWXYZ[\] ↑ ← SP !"#$%&'()*+,–./0123456789:;<=>?. The six bit ASCII code leaves two bits free and these may be externally connected to the mode pins ($\overline{\text{A}}$/G, $\overline{\text{A}}$/S, $\overline{\text{INT}}$/EXT, GM2, GM1, GM0, CSS or INV).
1	0	0	1	X	X	X	0 1	0 1 0 1	Green Black Orange Black	Black Green Black Orange	Black Black	32 Characters in columns 16 Characters in rows		one row of custom characters	The ALPHANUMERIC EXTERNAL mode uses an external character generator as well as a row counter. Thus, custom character fonts are graphic symbol sets with up to 256 different eight dot × 12 dot "characters" may be displayed.
1	0	1	0	X	X	X	X	X	Lx C2 C1 C0 0 X X X 1 0 0 0 1 0 0 1 1 0 1 0 1 0 1 1 1 1 0 0 1 1 0 1 1 1 1 0 1 1 1 1	Color Black Green Yellow Blue Red Buff Cyan Magenta Orange	Black	64 Display elements in columns 32 Display elements in rows	L_3 L_2 L_1 L_0 one element	C_2 C_1 C_0 L_3 L_2 L_1 L_0	The SEMIGRAPHICS FOUR mode uses an internal "course graphics" generator in which a rectangle (eight dots by twelve dots) is divided into four equal parts. The luminance of each part is determined by a corresponding bit on the VDG data bus. The color of illuminated parts is determined by three bits.
1	0	1	1	X	X	X	0 1	X	Lx C1 C0 0 X X 1 0 0 1 0 1 1 1 0 1 1 1 0 X X 1 0 0 1 0 1 1 1 0 1 1 1	Color Black Green Yellow Blue Red Black Buff Cyan Magenta Orange	Black	64 Display elements in columns 48 Display elements in rows	L_5 L_4 L_3 L_2 L_1 L_0	C_1 C_0 L_5 L_4 L_3 L_2 L_1 L_0	The SEMIGRAPHIC SIX mode is similar to the SEMIGRAPHIC FOUR mode with the following differences: The eight dot by twelve dot rectangle is divided into six equal parts. Color is determined by the two remaining bits.
1	1	X	X	0	0	0	0 1	X	C1 C0 0 0 0 1 1 0 1 1 0 0 0 1 1 0 1 1	Color Green Yellow Blue Red Buff Cyan Magenta Orange	Green Buff	64 Display elements in columns 64 Display elements in rows	E_3 E_2 E_1 E_0	C_1 C_0 C_1 C_0 C_1 C_0 C_1 C_0	The GRAPHICS ONE C mode uses a maximum of 1024 bytes of display RAM in which one pair of bits specifies one picture element.
1	1	X	X	0	0	1	0 1	X	Lx 0 1 0 1	Color Black Green Black Buff	Green Buff	128 Display elements in columns 64 Display elements in rows	L_7 L_6 L_5 L_4 L_3 L_2 L_1 L_0	L_7 L_6 L_5 L_4 L_3 L_2 L_1 L_0	The GRAPHICS ONE R mode uses a maximum of 1024 bytes of display RAM in which one bit specifies one picture element.
1	1	X	X	0	1	0	0 1	X	Same color as Graphics one C		Green Buff	128 Display elements in columns 64 Display elements in rows	E_3 E_2 E_1 E_0	C_1 C_0 C_1 C_0 C_1 C_0 C_1 C_0	The GRAPHICS TWO C mode uses a maximum of 2048 bytes of display RAM in which one pair of bits specifies one picture element.
1	1	X	X	0	1	1	0 1	X	Same color as Graphics one R		Green Buff	128 Display elements in columns 96 Display elements in rows	L_7 L_6 L_5 L_4 L_3 L_2 L_1 L_0	L_7 L_6 L_5 L_4 L_3 L_2 L_1 L_0	The GRAPHICS TWO R mode uses a maximum of 1536 bytes of display RAM in which one bit specifies one picture element.
1	1	X	X	1	0	0	0 1	X	Same color as Graphics one C		Green Buff	128 Display elements in columns 96 Display elements in rows	E_3 E_2 E_1 E_0	C_1 C_0 C_1 C_0 C_1 C_0 C_1 C_0	The GRAPHICS THREE C mode uses a maximum of 3072 bytes of display RAM in which one pair of bytes specifies one picture element.
1	1	X	X	1	0	1	0 1	X	Same color as Graphics one R		Green Buff	128 Display elements in columns 192 Display elements in rows	L_7 L_6 L_5 L_4 L_3 L_2 L_1 L_0	L_7 L_6 L_5 L_4 L_3 L_2 L_1 L_0	The GRAPHICS THREE R mode uses a maximum of 3072 bytes of display RAM in which one bit specifies one picture element.
1	1	X	X	1	1	0	0 1	X	Same color as Graphics one C		Green Buff	128 Display elements in columns 192 Display elements in rows	E_3 E_2 E_1 E_0	C_1 C_0 C_1 C_0 C_1 C_0 C_1 C_0	The GRAPHICS SIX C mode uses a maximum of 6144 bytes of display RAM in which one pair of bits specifies one picture element.
1	1	X	X	1	1	1	0 1	X	Same color as Graphics one R		Green Buff	256 Display elements in columns 192 Display elements in rows	L_7 L_6 L_5 L_4 L_3 L_2 L_1 L_0	L_7 L_6 L_5 L_4 L_3 L_2 L_1 L_0	The GRAPHICS SIX R mode uses a maximum of 6144 bytes of display RAM in which one bit specifies one picture element.

Software with Manual / Manual Alone

DIGITAL RESEARCH

☐ **CP/M* Floppy Diskette Operating System** — Packages supplied on diskette complete with 8080 assembler, text editor, 8080 debugger and various utilities plus full documentation. CP/M available configured for most popular computer/disk systems including: North Star Single, Double or Quad density, Altar 8" disks, Helios II, Exidy Sorcerer, Vector MZ, PolyMorphic 8813†‡ Heath H17† or H89†, TRS-80†, iCOM 3712 and iCOM Micro Disk plus many other configurations available off the shelf .... **$145/$25**

☐ **MAC** — 8080 Macro Assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Z-80 library included. Produces Intel absolute hex output plus symbols file for use by SID (see below) .... **$100/$15**

☐ **SID** — 8080 symbolic debugger. Full trace, pass count and break-point program testing system with back-trace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values .... **$85/$15**

☐ **TEX** — Test formatter to create paginated, page-numbered and justified copy from source text files, directable to disk or printer .... **$85/$15**

☐ **DESPOOL** — Program to permit simultaneous printing of data from disk while user executes another program from the console .... **$50/$10**

All Microsoft prices are discounted!

MICROSOFT

☐ **Disk Extended BASIC** — Version 5, ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records .... **$300/$25**

☐ **BASIC Compiler** — Language compatible with Version 5 Microsoft interpreter and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes Macro-80. Also linkable to FORTRAN-80 or COBOL-80 code modules .... **$350/$25**

☐ **FORTRAN-80** — ANSI '66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) .... **$400/$25**

☐ **COBOL-80** — ANSI '74 Relocatable object output. Format same as FORTRAN-80 and MACRO-80 modules. Complete ISAM, interactive ACCEPT/DISPLAY, COPY, EXTEND .... **$625/$25**

☐ **MACRO-80** — 8080/Z80 Macro Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included .... **$149/$15**

☐ **EDIT-80** — Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included **$89/$15**

MICRO FOCUS

☐ **CIS COBOL (standard)** — ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal .... **$850/$50**

☐ **CIS COBOL (compact)** — COBOL subset compiler for use on a 32K byte microcomputer. Valuable range of COBOL language features, many at level 2 and including ISAM and the CIS COBOL interactive screen formatting of dumb terminals .... **$650/$50**

☐ **Forms 1** — CRT screen editor to build application CRT formats with protected and unprotected field areas. Output is COBOL data descriptions for copying into CIS COBOL programs. Eliminates the chore of writing screen input and output descriptions by hand and greatly speeds interactive application programming. Output requires CIS COBOL compact compiler .... **$125/$20**

☐ **Forms 2** — Forms 1 screen editor plus indexed file application program generator. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. No programming experience needed. Output program directly compiled by either of CIS COBOL compilers .... **$200/$20**

EIDOS SYSTEMS

☐ **KISS** — Keyed Index Sequential Search. Offers complete Multi-Keyed Index Sequential and Direct Access file management. Includes built-in utility functions for 16 or 32 bit arithmetic, string/integer conversion and string compare. Delivered as a relocatable linkable module in Microsoft format for use with FORTRAN-80 or COBOL-80, etc. .... **$535/$23**

☐ **KBASIC** — Microsoft Disk Extended BASIC with all KISS facilities, integrated by implementation of nine additional commands in language. Package includes KISS.REL as described above, and a sample mail list program .... **$995/$45**

*CP/M is a trade name of Digital Research.
**Z80 is a trademark of Zilog, Inc.
***UNIX is a trademark of Bell Laboratories.
****WHATSIT? is a trademark of Computer Headware.
†CP/M for Heath, TRS-80 Model I and PolyMorphic 8813 are modified and must use especially compiled versions of system and applications software.
††PolyMorphic 8813 CP/M scheduled for September 15 release.

All Micropro prices are discounted!

Software with Manual / Manual Alone

MICROPRO

☐ **Super-Sort I** — Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. etc. Even variable number of fields per record! .... **$225/$25**

☐ **Super-Sort II** — Above available as absolute program only .... **$175/$25**

☐ **Super-Sort III** — As II without SELECT/EXCLUDE .... **$125/$25**

☐ **Word-Star** — Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center and underscore. User can print one document while simultaneously editing a second. Edit facilities include global search and replace, read/write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning **$445/$25**

☐ **Word-Master** Text Editor — In one mode has superset of CP/M's ED commands including global searching and replacing, forward and backwards in file. In video mode, provides full screen editor for users with serial addressable-cursor terminal .... **$125/$25**

SOFTWARE SYSTEMS

☐ **CBASIC-2** Disk Extended BASIC — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables, etc. .... **$109/$15**

Structured Systems prices are discounted!

STRUCTURED SYSTEMS GROUP

☐ **General Ledger** — Interactive and flexible system providing proof and report outputs. Customization of COA created interactively. Multiple branch accounting centers. Extensive checking performed at data entry for proof, COA correctness, etc. Journal entries may be batched prior to posting. Closing procedure automatically backs up input files. All reports can be tailored as necessary. Requires CBASIC .... **$899/$25**

☐ **Accounts Receivable** — Open item system with output for internal aged reports and customer-oriented statement and billing purposes. On-Line Enquiry permits information for Customer Service and Credit departments. Interface to General Ledger provided if both systems used. Requires CBASIC .... **$699/$25**

☐ **Accounts Payable** — Provides aged statements of accounts by vendor with check writing for selected invoices. Can be used alone or with General Ledger and/or with NAD. Requires CBASIC .... **$699/$25**

☐ **LETTERIGHT** — Program to create, edit, and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC .... **$179/$25**

☐ **NAD** Name and Address selection system — interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC .... **$79/$20**

☐ **QSORT** — Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created. .... **$95/$20**

GRAHAM-DORIAN SOFTWARE SYSTEMS

☐ **PAYROLL SYSTEM** — Maintains employee master file. Computes payroll withholding for FICA, Federal and State taxes. Prints payroll register, checks, quarterly reports and W-2 forms. Can generate ad hoc reports and employee form letters with mail labels. Requires CBASIC. Supplied in source code. .... **$590/$35**

☐ **APARTMENT MANAGEMENT SYSTEM** — Financial management system for receipts and security deposits of apartment projects. Captures data on vacancies, revenues, etc. for annual trend analysis. Daily report shows late rents, vacancy notices, vacancies, income lost through vacancies, etc. Requires CBASIC. Supplied in source code. .... **$590/$35**

☐ **INVENTORY SYSTEM** — Captures stock levels, costs, sources, sales, ages, turnover, markup, etc. Transaction information may be entered for reporting by salesman, type of sale, date of sale, etc. Reports available both for accounting and decision making. Requires CBASIC. Supplied in source code. .... **$590/$35**

☐ **CASH REGISTER** — Maintains files on daily sales. Files data by sales person and item. Tracks sales, overrings, refunds, payouts and total net deposits. Requires CBASIC. Supplied in source code .... **$590/$35**

☐ **tiny C** — Interactive interpretive system for teaching structured programming techniques. Manual includes full source listings .... **$75/$40**

Prices and specifications subject to change without notice.

Software with Manual / Manual Alone

☐ **BDS C Compiler** — Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation, linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie .... **$110/$15**

☐ **Whitesmiths' C Compiler** — The ultimate in systems software tools. Produces faster code than Pascal with more extensive facilities. Conforms to the full UNIX*** Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Compiler output in A-Natural source. Supplied with A-Natural (see below) requires 60K CP/M .. **$630/$30**

☐ **A-Natural** — Narrative assembler with linking loader, librarian, extensive 8080 subroutine library in A-Natural relocatable format and translators from A-Natural source to Microsoft MACRO-80 source and from A-Natural rel to source .... **$330/$15**

☐ **ALGOL 60 Compiler** — Powerful block-structured language featuring economical run time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling direct disk address I/O etc. Requires Z80 CPU .... **$199/$20**

☐ **Z80 Development Package** — Consists of: (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file. .... **$95/$20**

☐ **ZDT** — Z80 Debugger to trace, break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. Facilities similar to DDT. $35 when ordered with Z80 Development Package .... **$50/$10**

☐ **DISTEL** — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL/Xitan pseudo ops optional. Runs on 8080. .... **$65/$10**

☐ **DISILOG** — As DISTEL to Zilog Mostek mnemonic files. Runs on Z80 only .... **$65/$10**

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TYPICAL MINIMUM AND MAXIMUM SYSTEMS

The VDG, a RAM or ROM (a ROM would be preferable since no MPU is around to store display data), and the linear modulator make a complete display system. Refer to Figure 1 for a basic display block diagram. The VDG is controlled by eight lines which may be hardwired, logically controlled through the use of TTL (Transistor Transistor Logic) and/or a PIA (Peripheral Interface Adaptor), or tied to the data lines of another block of RAM.

Before continuing, a brief explanation about the PIA is due. The MC6820 is a universal device for interfacing the MPU to peripheral instruments and equipment such as terminals, printers, cassette decks, keyboards, etc. with no or minimal external logic through two 8-bit bidirectional peripheral data buses and four handshake control lines.

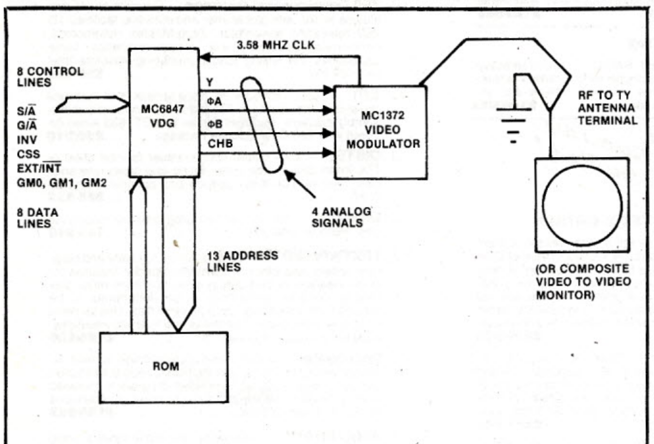


Figure 1. Block diagram of a simple display system.

During system initialization each of the sixteen data lines may be individually programmed as an input or output with a number of variations available for the type of handshake, control, or interrupt needed. A brief discussion of the above VDG control methods will be discussed shortly. The VDG increments through the address bus to the display RAM or ROM. The memory in turn outputs data to the VDG which interprets each byte according to the input on the control lines. The VDG outputs the video information on one pin and the chrominance information on two other pins.

Sync 1.0V

Blank 0.75V

Black 0.7V

White Low 0.62V

White Medium 0.5V

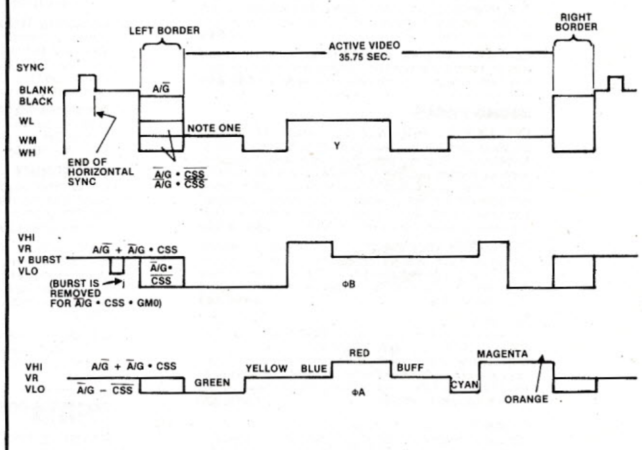
White High 0.38V

Figure 2. Nominal Luminance Levels.

(See Figure 2 for nominal luminance levels; see Figures 3 and 4 for horizontal and vertical output waveforms from the VDG.) The MC1372 modulator puts out the needed RF to the antenna terminals of a color or black and white television set. The outputs of the VDG feed into the RF oscillator modulator, which not only develops the RF carrier and final composite video signal complete with color burst, but also generates a 3.58 MHz crystal controlled clock for the VDG.

Table 2. Recommended Chroma-Luma Signals

	Pin #9 Luminance Input (Vdc)	Pin #7 Color A (Vdc)	Pin #6 Color Ref. (Vdc)	Pin #5 Color B (Vdc)
Sync	1.0	1.5	1.5	1.5
Blanking	0.75	1.5	1.5	1.5
Burst	0.75	1.5	1.5	1.25
Black	0.70	1.5	1.5	1.5
Green	0.50	1.0	1.5	1.0
Yellow	0.38	1.5	1.5	1.0
Blue	0.62	1.5	1.5	2.0
Red	0.62	2.0	1.5	1.5
Cyan	0.50	1.0	1.5	1.5
Magenta	0.50	2.0	1.5	2.0
Orange	0.50	2.0	1.5	1.0
Buff	0.38	1.5	1.5	1.5



NOTE:
1. The 3.58MHz Video must be in phase for every horizontal line, every field and every frame.
2. Horizontal timing non-interlaced option.

Figure 3. Video and Chrominance Output Waveform Relationships.

Refer to Table 2 for nominal chroma and luma input signals to the MC1372.

Now for a brief discussion on control methods. Hardwiring the control lines or using switches will allow manual operational control. The use of TTL or a PIA enables the user to switch modes on the fly under software control. This method must be under constant supervision of the MPU. The third method involves using twice as much RAM. Control RAM uses 8 bits and display data uses 8 bits (Figure 5). The MPU accesses two blocks of RAM, each 6K by 8 of bits making the available RAM look like 21K by 8 bits.

The software will initially have to know where mode information goes with respect to the display data. When the MPU is through reading and/or writing to the RAM, the VDG takes over and the blocks of RAM are simultaneously selectable by the VDG. This gives the MC6847 a memory block of 6K by 16 bits. This is allowing for a maximum system with a maximum amount of RAM. A reduction to 13 bits of RAM may be achieved by connecting some don't care data lines to

Something New on the Horizon from Technical Systems Consultants

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Finally, a BASIC for serious business applications or scientific programming is available. All the features of our regular BASIC are supported—and more. Floating point calculations are carried out to an internal accuracy of 17 digits. Most math functions are accurate to 16 digits with a minimum accuracy of 13.5 digits. Integer variables have been included to allow fast execution of control loops and array indexing. Even with the double precision math package, this BASIC is still one of the fastest around.

The business programmer will appreciate the versatile PRINT-USING capabilities which include dollar and asterisk fill, trailing minus sign, imbedded commas, and scientific notation. New string functions have been added for string searching (INSTR) and for creating a string which is the date (DATES$). DPEEK and DPOKE are 16-bit peek and poke type functions. The SCALE command has been included to eliminate the round-off errors typically encountered in binary math packages. The INCH$ function allows single-character input from the terminal. Programmer control of control C breaks is also included.

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SP09-6	**6809 Extended BASIC**	**$100**

BASIC Precompiler

This program allows the creation of BASIC programs without the use of line numbers or restrictive two-character variable names. Alphanumeric line and subroutine labels may be used, as well as variable names of any length. Comment lines are marked with non-alphanumerics for easy readability. The output of the precompiler is in the standard BASIC compiled form. This allows applications programs to be written, precompiled, and then distributed in a non-source form. The precompiler can only be used with one of Technical Systems Consultants' BASICs. Specify 8″ or 5″ (5″ 6800 is FLEX™ 2.0) when ordering.

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AP68-14	**Double Precision 6800 Precompiler**	**$50**
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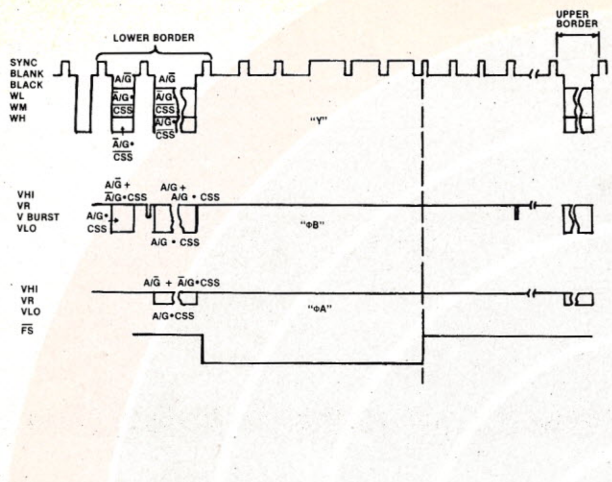


Figure 4. Vertical Output Non-Interlaced Option.

each other as in Figure 6, and if the Color Set Select pin is hardwired or connected otherwise (say to a PIA) then 6K by 12 bits would allow for a maximum system.

Table 3 decodes the pin connections for the various modes. Speaking of decoding, all the necessary signals for the maximum system are developed in Figure 5. The Read/Write and Enable signals are clocked with $\phi 2$ and Valid Memory Address inputs. Selection of the upper and lower 8K memory blocks is available, but the user will need to decode the individual RAMs in each block if 8K RAMs are not available. Similar yet "smaller" systems could use 1K by 13 or 12 bits using this idea. All modes could still be used. The software program in ROM would keep the display system under con-

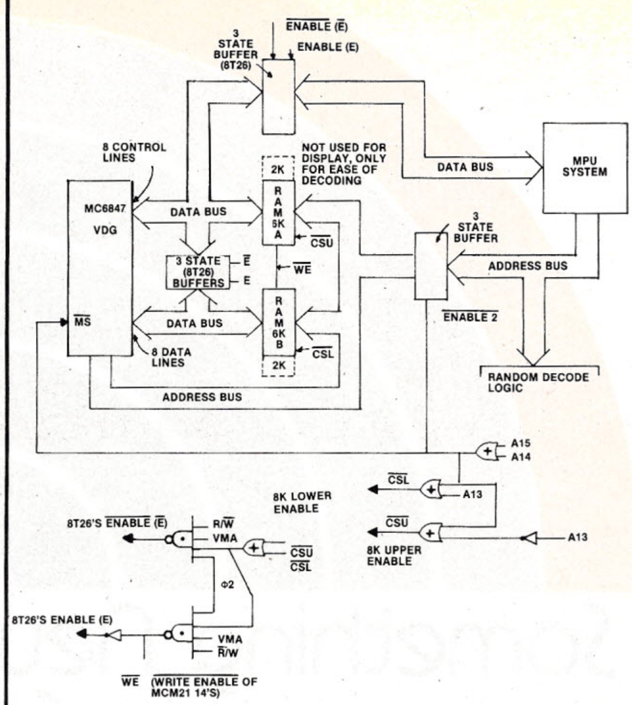


Figure 5. Maximum System.

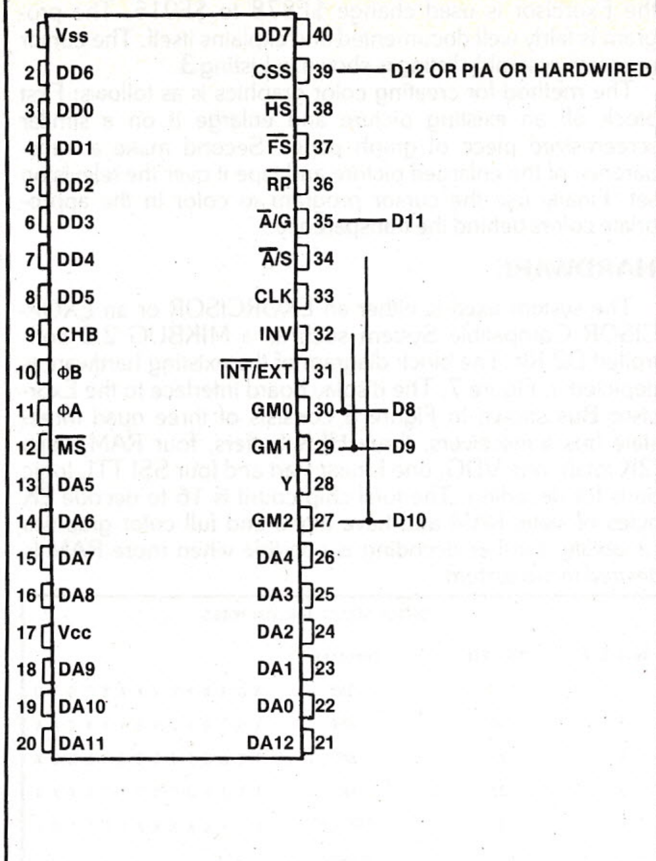


Figure 6. VDC Mode Control Connections.

Table 3. VDG Mode Selection

D_{11}	D_{10}	D_9	D_8	MODE
0	0	0	0	Internal Alpha Numerics
0	0	0	1	External Alpha Numerics
0	0	1	0	Internal Alpha Numerics Inverted
0	0	1	1	External Alpha Numerics Inverted
0	1	X	0	Semigraphics 4
0	1	X	1	Semigraphics 6
1	0	0	0	Graphics Mode 0
1	0	0	1	Graphics Mode 1
1	0	1	0	Graphics Mode 2
1	0	1	1	Graphics Mode 3
1	1	0	0	Graphics Mode 4
1	1	0	1	Graphics Mode 5
1	1	1	0	Graphics Mode 6
1	1	1	1	Graphics Mode 7

stant supervision. The program would need to determine the number of scan lines desired in any particular mode enabling ease of mode changing, where the memory address ought to be (as far as the VDG is concerned), and if object code is used, where it is and where it ought to go in memory.

These considerations as well as general housekeeping must be taken into account by the system's microprocessor. Another way of enhancing performance with fewer parts is to use a bi-phase method. If the VDG is used with a MC6800 family microprocessor then 6K of RAM could be displayed using only 1K of actual in-system RAM.

If the Interlaced VDG is used, a flip flop could choose between memory banks of 6K each (maximum type system — less memory could be used incorporating some of the other

ideas) allowing for smaller characters on the screen since it is now effectively twice as dense as before. The flip flop is toggled by the Field Synchronization pulse enabling different information to be displayed every field change instead of having the same dot for both fields, thus allowing mapping of 98,304 bits.

SOFTWARE

Three programs are incorporated within. The first program shown in Listing 1 is extremely short and uses two modes: Alphanumerics and Semigraphics-4 mode. The data in the display memory is incremented every location to show the color and character capabilities. The alphanumerics inverted and non-inverted characters will appear first. Then two columns of four rows each with blocks of color will appear from left to right like this: green, yellow, blue, red, buff, cyan, magenta and orange. They will also appear in all the possible combinations of illumination. The VDG TEST program only loads up the display memory with successively incremented numbers and then returns control to the monitor program.

The second program shown in Listing 2 is a short piece of coding to demonstrate terminal possibilities. The program was written to run with a MIKBUG 2.0 monitor, therefore, the input routine is at $F878. If an Exorcisor is being used, replace $F878 with $F015, the input without parity routine INCHNP. The program is extremely limited; it allows only alphanumeric characters (inverted and noninverted). This could use Semigraphics-4 if the user reconfigures the software for control characters putting the desired information into the display memory. In this instance the most significant bit, bit 7, indicates Alpha or Semigraphics-4.

The only special functions allowed are backspacing and escaping to the monitor. Other commands may easily be added by the user. Oddly enough the backspace key and the escape key were chosen for their respective functions. The program is not for a stand alone system; in other words the system used must already have a fully functional terminal. The program returns to the top left hand corner of the screen after the last character is input at the bottom right hand corner of the television screen.

This program may be added to quite easily. All the control characters should be checked over before any character is thrown into the display RAM and those comparisons and branches should be inserted at $0222 between the BEQ ESC and STA A 00, X instructions. The actual code for implementation of each additional control character is placed after the ESC SWI instruction (ESC is the label and SWI is the mnemonic for the instruction Software Interrupt).

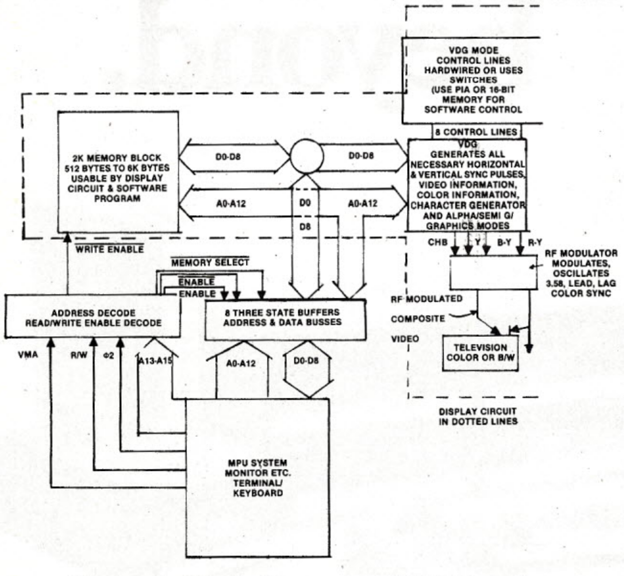


Figure 7. Block Diagram of VDG Board.

The third (and last) program is for cursor control. Again, if the Exorcisor is used change $F878 to $F015. The program is fairly well documented and explains itself. The cursor program assembly listing is shown in Listing 3.

The method for creating color graphics is as follows: First block off an existing picture and enlarge it on a similar screen-sized piece of graph paper. Second make a transparency of the enlarged picture and tape it over the television set. Finally use the cursor program to color in the appropriate colors behind the transparency.

HARDWARE

The system used is either an EXORCISOR or an EXORCISOR Compatible System such as a MIKBUG 2.0 controlled D2 Kit. The block diagram of the existing hardware is depicted in Figure 7. The display board interface to the Exorcisor Bus shown in Figure 8 consists of three quad three-state bus transceivers, three HEX buffers, four RAM chips (2K total), one VDG, one Linear Part and four SSI TTL logic parts for decoding. The total chip count is 16 to decode 2K bytes of static RAM and have alpha and full color graphics capability. Further decoding is possible when more RAM is desired in the system.

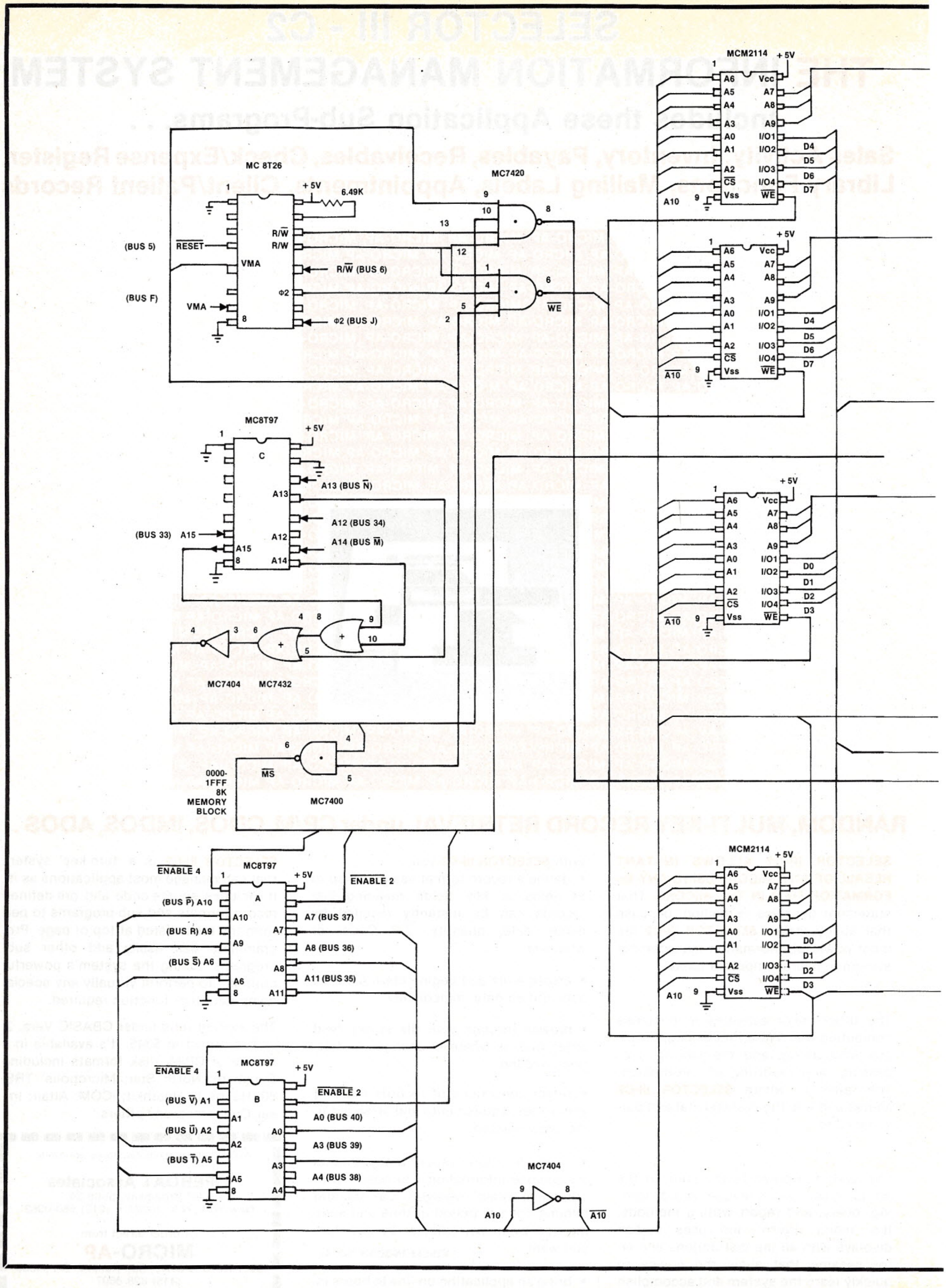
SWITCH SELECT FOR VDG MODES

Switch #	VDG Pin	Function														
		INV	X	X	X	X	X	X	X	X	X	X	1	0	1	0
1	30	GMØ	1	0	1	0	1	0	1	0	X	X	X	X	X	X
2	29	GM1	1	1	0	0	1	1	0	0	X	X	X	X	X	X
3	27	GM2	1	1	1	1	0	0	0	0	X	X	X	X	X	X
4	31	$\overline{\text{INT}}$/EXT	X	X	X	X	X	X	X	X	1	0	1	1	0	0
5	34	$\overline{\text{ALPHA}}$/ SEMI GRAPHICS	X	X	X	X	X	X	X	X	1	1	0	0	0	0
6	35	$\overline{\text{ALPHA}}$/ GRAPHICS	1	1	1	1	1	1	1	1	0	0	0	0	0	0.
7	39	CSS														
			256X192 GRAPHICS	128X192 COLOR GRAPHICS	128X96 GRAPHICS	128X96 COLOR GRAPHICS	128X96 GRAPHICS	128X64 COLOR GRAPHICS	128X64 GRAPHICS	64X64 COLOR GRAPHICS	SEMI GRAPHICS 6	SEMI GRAPHICS 4	EXT ALPHA INV	EXT ALPHA	INT ALPHA INV	INT ALPHA

Figure 9. VDG Mode Switches

Note the OR gate with the output to $\overline{A}$/S of the VDG. This gate enables either software or hardware control of the Semigraphics modes. Software control is desired when switching between Alpha and Semigraphics-4 mode. The hardware switch input to the OR gate is to cancel out the effects of Data bit 7 on the control pins when Semigraphics-6 mode is desired. If the gate were not present the switch and resistors would conflict with the data bus bit 7 causing sections on the screen to flicker, resulting in unreliably displayed data.

All control pins (as well as the data bus) must have "solid" information on them and must *not be left floating* at an unknown state. Good grounding of the connectors around the RF output and shielding high frequency areas will enhance the appearance of the television display. The capacitor values around the 3.58 crystal are not extremely critical, but for individual systems a trimmer capacitor may replace the 15 pf capacitor. The mode choice, via the switches, is shown in Figure 9.☐ **Figures & Listings follow**


MCM2114
+5V
A6 A5 A4 A3 A0 A1 A2 CS Vss
Vcc A7 A8 A9 I/O1 I/O2 I/O3 I/O4 WE
D4 D5 D6 D7
D0 D1 D2 D3
A10
MC 8T26
6.49K
R/W
RESET
VMA
Φ2
(BUS 5)
(BUS F)
R/W (BUS 6)
Φ2 (BUS J)
MC7420
WE
MC8T97
A13 (BUS N)
A12 (BUS 34)
A14 (BUS M)
(BUS 33) A15
MC7404
MC7432
MC7400
MS
0000-
1FFF
8K
MEMORY
BLOCK
ENABLE 4
ENABLE 2
(BUS P) A10
(BUS R) A9
(BUS S) A6
A7 (BUS 37)
A8 (BUS 36)
A11 (BUS 35)
(BUS V) A1
(BUS U) A2
(BUS T) A5
A0 (BUS 40)
A3 (BUS 39)
A4 (BUS 38)

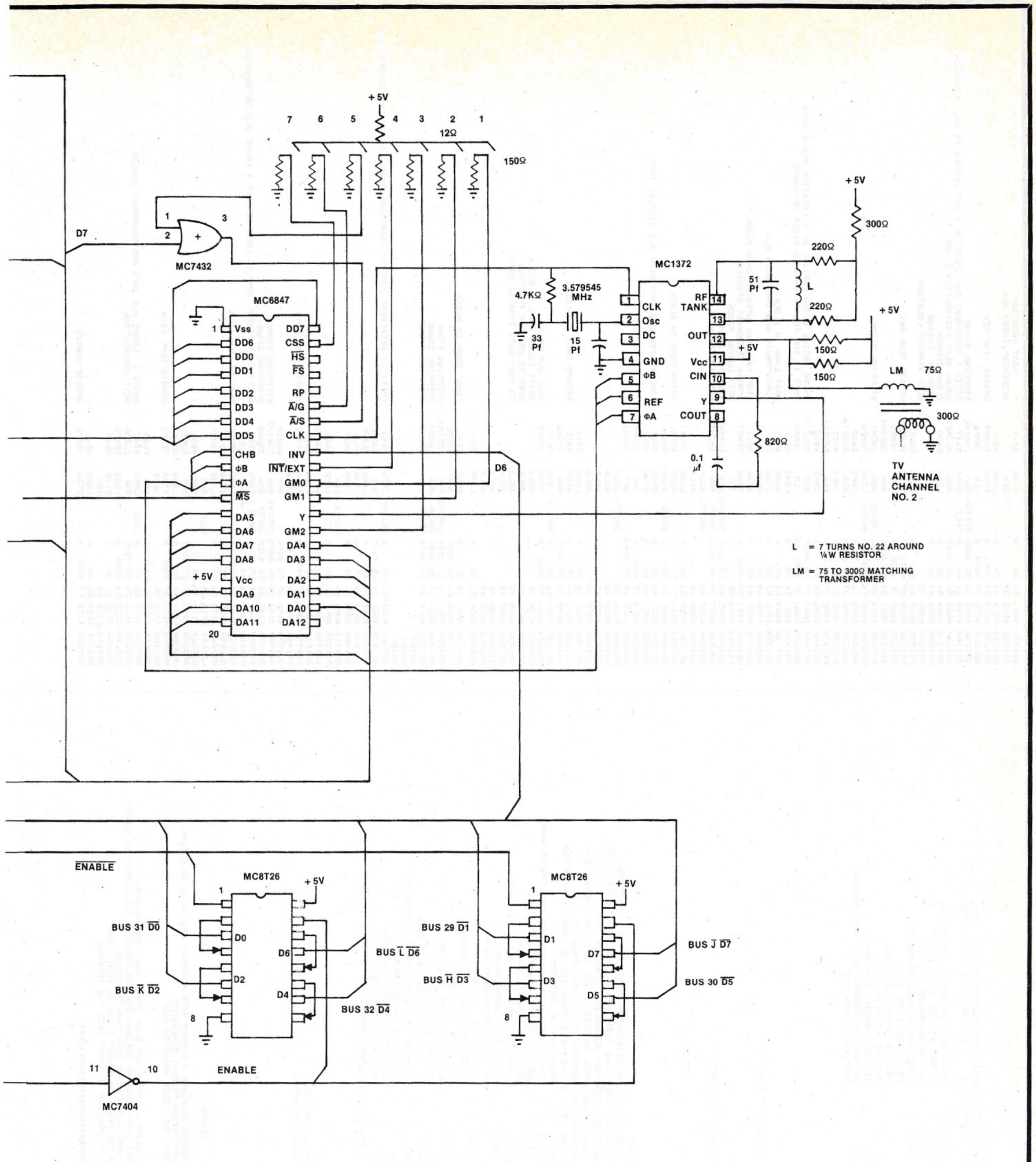

+5V
12Ω
150Ω
D7
MC7432
MC6847
Vss
DD6
DD0
DD1
DD2
DD3
DD4
DD5
CHB
ΦB
ΦA
MS
DA5
DA6
DA7
DA8
+5V
Vcc
DA9
DA10
DA11
DD7
CSS
HS
FS
RP
A/G
A/S
CLK
INV
INT/EXT
GM0
GM1
Y
GM2
DA4
DA3
DA2
DA1
DA0
DA12
D6
4.7KΩ
3.579545 MHz
33 Pf
15 Pf
MC1372
CLK
Osc
DC
GND
ΦB
REF
ΦA
RF TANK
OUT
Vcc
CIN
Y
COUT
51 Pf
L
220Ω
300Ω
150Ω
LM
75Ω
820Ω
0.1 μf
TV ANTENNA CHANNEL NO. 2
L = 7 TURNS NO. 22 AROUND ¼W RESISTOR
LM = 75 TO 300Ω MATCHING TRANSFORMER
ENABLE
MC8T26
BUS 31 D0
BUS K D2
BUS L D6
BUS 32 D4
BUS 29 D1
BUS H D3
BUS J D7
BUS 30 D5
ENABLE
MC7404

Figure 8.

LISTING 1

```
                        NAM VDGTEST
                  *  THIS PROGRAM DEMONSTRATES THE ALPHANUMERICS MODE
                  *  AND THE SEMI GRAPHICS 4 ( 8 COLORS PLUS BLACK MODE)
                  *
0210                    ORG $0210       BEGINING OF DISPLAY PROGRAM
0210 CE 00 00           LDX #$0000      START ADD OF DISPLAY IN X REG
0213 86 00              LDA A #$00      ACC A INCREMENTS DATA
0215 A7 00      CONT    STA A 00,X      LOAD UP DISPLAY MEMORY
0217 4C                 INC A           NEXT PIECE OF INFO
0218 08                 INX             NEXT DISPLAY LOCATION
0219 8C 02 00           CPX #$0200      ENTIRE DISPLAY FULL
021C 27 03              BEQ STOP        IF FULL THEN STOP PROG
021E 7E 02 15           JMP CONT        IF NOT INCREMENT DATA AND MEMORY
0221 3F         STOP    SWI             RETURN TO MONITOR
                        END
      NO ERROR(S) DETECTED


  SYMBOL TABLE:

S1130210CE00008600A7004C088C020027037E0253
S1050220153F84S9
MIKBUG 2.0
*

S1130210CE00008600A7004C088C020027037E0253
S1050220153F84S9
MIKBUG 2.0
*
```

LISTING 2

```
                        NAM VDGMOT
                  *  THIS IS A VIDEO DISPLAY GENERATOR MINI-OUTPUT TERMINAL
                  *  IT ACCEPTS INPUTS FROM THE TERMINAL AND DISPLAYS THE INFO
                  *  ON THE TELEVISION SCREEN: NORMALLY INVERTED FOR
                  *  ALPHA AND NONINVERTED FOR NUMERICS AND SPECIAL CHARACTERS
                  *  THE OTHER (INVERT OR NONINVERT) IS ACHIEVED BY
                  *  DEPRESSING THE CONTROL KEY AND THEN THE DESIRED CHARACTER
0210                    ORG $0210       BEGINING OF PROGRAM
0210 CE 00 00   START   LDX #$0000      LOAD X REG WITH START ADD OF SCREEN RAM
0213 86 20              LDA A #$20      LOAD AN ASCII BLANK INTO ACC A
0215 A7 00              STA A 00,X      DISPLAY CONTENTS OF ACC A
0217 BD F8 78   CONT    JSR $F878       JUMP TO INPUT ROUTINE INCH
021A 81 08              CMP A #$08      ASCII BS?  BACKSPACE
021C 27 0F              BEQ BS          IF SO GO DECREMENT X REG
021E 81 1B              CMP A #$1B      ASCII ESC?  EXCAPE
0220 27 0E              BEQ ESC         IF SO JUMP OUT OF PROGRAM
0222 A7 00              STA A 00,X      PUT DATA IN DISPLAY
0224 08                 INX             NEXT LOCATION IN DISPLAY
0225 8C 02 00   TOP     CPX #$0200      AT END OF DISPLAY?
0228 27 E6              BEQ START       IF SO: GO TO TOP OF SCREEN
022A 7E 02 17           JMP CONT        IF NOT:  GO INPUT NEXT CHARACTER
022D 09         BS      DEX             BACKSPACE BY DECREMENTING X REG
022E 20 F5              BRA TOP         CONTINUE THROUGH PROGRAM
0230 3F         ESC     SWI             RETURN TO MONITOR
                  *  VDGMOT IS USABLE IN THE SEMIGRAPHICS & GRAPHICS MODES
                        END
     NO ERROR(S) DETECTED
  SYMBOL TABLE:

S1130210CE00008620A700BDF8788108270F811B37
S1130220270EA700088C020027E67E0217092UF596
S10402303F8AS9
MIKBUG 2.0
*
```

LISTING 3

```
PAGE  001    CURSOR

                             NAM    CURSOR
                       *
                       *  THIS PROGRAM DISPLAYS A CURSOR WITH MOVEMENT AND COLOR SELECTION
                       *  THE MC6847 VIDEO DISPLAY GENERATOR
                       *  IS IN ANY FOUR COLOR GRAPHICS MODE
                       *
                       *
                       *   MEMORY SETUP:   THERE ARE FOUR INDIVIDUAL 'CHARACTERS'
                       *   BY THREE SCAN LINES OF INFORMATION PER LOCATION (OR BLOCK) IN MEMORY
                       *   COLOR GOES INTO ONE OF FOUR CHAR POSITIONS
                       *   WITHIN THE BLOCK OR MEMORY LOCATION EVERY TIME
                       *   COLOR INFORMATION IS INPUT FROM THE TERMINAL
                       *
                       *   *****************************
                       *   *     *     *     *     *
```

```
4073 A7 00      A         STAA  00,X     *   LAST LOCATION
4075 09                   DEX            DECREMENT INDEX REG
4076 A6 00      A         LDAA  00,X
4078 B7 4001    A         STAA  TEMP5    UPDATE TEMP REG
407B 7F 4000    A         CLR   TEMPO
407E 20 8E 400E CURIN4    BRA   CURINC   STEPPING STONE
4080 81 49      A INCZ    CMPA  #$49     ASCII I INCREMENT ONE LOCATION & PUT ZEROES IN LAST LOCATION
4082 26 65 40E9           BNE   DCJMP1   CHECK NEXT INSTRUCTION IF NOT I
4084 86 00      A         LDAA  #$00     CLEAR CURSOR
4086 A7 00      A         STAA  00,X     DISPLAY  CURSOR
4088 08                   INX            NEXT DISPLAY LOCATION
4089 A6 00      A         LDAA  00,X
408B B7 4001    A         STAA  TEMP5    UPDATE TEMP REG
408E 7F 4000    A         CLR   TEMPO
4091 20 EB 407E           BRA   CURIN4
4093 20 CD 4062 INCH2     BRA   INCH3    STEPPING STONE
4095 F6 4000    A MAIN1   LDAB  TEMPO
4098 C1 00      A         CMPB  #$00
409A 27 38 40D4           BEQ   SHIFT6
409C C1 01      A         CMPB  #$01
409E 27 2A 40CA           BEQ   SHIFT4
40A0 C1 02      A         CMPB  #$02
40A2 27 15 40B9           BEQ   SHIFT2   THESE DECIDE WHICH PORTION OF A LOCATION NEEDS DATA
40A4 7F 4000    A         CLR   TEMPO    THIS IS THE FOURTH CHAR IN BLOCK OF CHARS
40A7 E6 00      A         LDAB  00,X
40A9 C4 FC      A         ANDB  #$FC     LAST CHAR IN BLOCK
40AB E7 00      A         STAB  00,X     CONCATONATE NEW INFO WITH OLD
40AD AA 00      A         ORAA  00,X
40AF A7 00      A         STAA  00,X     DISPLAY FINAL UPDATED CHAR BLOCK
40B1 B7 4001    A         STAA  TEMP5    UPDATE TEMPORARY STORAGE
40B4 08                   INX            NEXT CURSOR BLOCK
40B5 20 C7 407E CURIN3    BRA   CURIN4   STEPPING STONE
40B7 20 A9 4062 INCH7     BRA   INCH3    STEPPING STONE
40B9 48           SHIFT2  ASLA
40BA 48                   ASLA
40BB E6 00      A         LDAB  00,X
40BD C4 F3      A         ANDB  #$F3     THIRD CHAR IN BLOCK
40BF E7 00      A STORE   STAB  00,X
40C1 AA 00      A         ORAA  00,X     CONCATONATE NEW INFO WITH OLD DISPLAY INFO
40C3 A7 00      A         STAA  00,X
40C5 7C 4000    A         INC   TEMPO
40C8 20 C9 4093           BRA   INCH2
40CA 48           SHIFT4  ASLA
40CB 48                   ASLA
40CC 48                   ASLA
40CD 48                   ASLA
40CE E6 00      A         LDAB  00,X
40D0 C4 CF      A         ANDB  #$CF     SECOND CHAR IN BLOCK
40D2 20 EB 40BF           BRA   STORE
40D4 E6 00      A SHIFT6  LDAB  00,X
40D6 F7 4001    A         STAB  TEMP5    SAVE OLD DATA
40D9 48                   ASLA           SHIFT COLOR INFO IN ACC A
40DA 48                   ASLA           OVER TO CORRECT POSITION
40DB 48                   ASLA           TO 'OR' WITH DISPLAY INFO
40DC 48                   ASLA
40DD 48                   ASLA
40DE 48                   ASLA
40DF E6 00      A         LDAB  00,X

40E1 C4 3F      A         ANDB  #$3F     FIRST CHAR IN BLOCK
40E3 20 DA 40BF           BRA   STORE
40E5 20 CE 40B5 CURIN2    BRA   CURIN3   STEPPING STONE
40E7 20 CE 40B7 INCH8     BRA   INCH7    STEPPING STONE
40E9 20 00 40EB DCJMP1    BRA   DECJMP   STEPPING STONE
                *
                *
                *
40EB 81 4A      A DECJMP  CMPA  #$4A     ASCII  J DECREMENT JUMP 10 LOCATIONS DOWN & LEAVE OLD INFORMATION
40ED 26 18 4107           BNE   INCOLD
40EF F6 4001    A         LDAB  TEMP5
40F2 E7 00      A         STAB  00,X
40F4 C6 09      A         LDAB  #$09
40F6 09           AGAIN   DEX
40F7 C1 00      A         CMPB  #$00
40F9 27 EA 40E5           BEQ   CURIN2
40FB A6 00      A         LDAA  00,X
40FD B7 4001    A         STAA  TEMP5    UPDATE TEMP DATA
4100 5A                   DECB
4101 20 F3 40F6           BRA   AGAIN
4103 20 E0 40E5 CURIN1    BRA   CURIN2   STEPPING STONE
4105 20 E0 40E7 INCH9     BRA   INCH8    STEPPING STONE
4107 81 55      A INCOLD  CMPA  #$55     ASCII U INCREMENT JUMP 10 LOCATIONS UP & LEAVE OLD INFORMATION
4109 26 14 411F           BNE   LOLD
410B F6 4001    A         LDAB  TEMP5    RESTORE OLD INFO
410E E7 00      A         STAB  00,X
4110 C6 09      A         LDAB  #$09
4112 08           PLUS    INX
4113 C1 00      A         CMPB  #$00
4115 27 EC 4103           BEQ   CURIN1
4117 A6 00      A         LDAA  00,X
4119 B7 4001    A         STAA  TEMP5    UPDATE TEMP DATA
411C 5A                   DECB
411D 20 F3 4112           BRA   PLUS
411F 81 4C      A LOLD    CMPA  #$4C     ASCII L  LEAVE OLD INFO AND INCREMENT CURSOR
4121 26 0D 4130           BNE   CLEAR    NEXT INSTRUCTION
4123 F6 4001    A         LDAB  TEMP5
4126 E7 00      A         STAB  00,X
4128 08                   INX
4129 E6 00      A         LDAB  00,X
412B F7 4001    A         STAB  TEMP5    UPDATE CURSOR
```

```
00017                    *    *     *     *     *     *
00018                    *    *****************************
00019                    *    THE CURSOR MOVES ALONG EACH INDIVIDUAL
00020                    *    BLOCK AS THE DESIRED COLOR IS SELECTED.
00021                    *    A CHOICE OF ONE OF TWO 4 COLOR SETS IS POSSIBLE
00022                    *    WITH EITHER A SWITCH, A PIA OR RANDOM LOGIC
00023                    *    THE SAME HOLDS TRUE ABOUT THE OTHER CONTROL PINS
00024                    *
00025                    *
00026                    *         ACCEPTABLE INPUTS
00027                    *
00028                    *    W    WHITE OR BUFF COLOR GOES IN BLOCK
00029                    *    G    GREEN COLOR GOES IN BLOCK
00030                    *    C    CYAN    "    "    "    "
00031                    *    Y    YELLOW  "    "    "    "
00032                    *    M    MAGENTA COLOR GOES IN BLOCK
00033                    *    B    BLUE    "    "    "    "
00034                    *    O    ORANGE  "    "    "    "
00035                    *    R    RED     "    "    "    "
00036                    *    S    START PROGRAM OVER FROM BEGINNING
00037                    *    N    DECREMENT CURSOR ONE LOCATION AND LEAVE OLD DATA
00038                    *    E    END OR FINISH PROGRAM BY GOING BACK TO MONITOR
00039                    *    F    FINISH OR END PROGRAM BY GOING BACK TO MONITOR
00040                    *    D    DECREMENT ONE LOCATION AND CLEAR LAST LOCATION
00041                    *    I    INCREMENT ONE LOCATION AND CLEAR LAST LOCATION
00042                    *    J    JUMP 10 LOCATIONS DOWN IN MEMORY AND UP ON SCREEN & LEAVE OLD INFO
00043                    *    U    JUMP 10 LOCATIONS UP IN MEMORY AND DOWN ON SCREEN AND LEAVE OLD INFO
00044                    *    L    LEAVE OLD INFO AND INCREMENT CURSOR ONE LOCATION
00045                    *    CNTRL C    CLEARS THE AMOUNT OF DISPLAY MEMORY INPUT AFTER
00046                    *         THE CNTRL C COMMAND: 5 CLEARS 512 BYTES, 1 CLEARS 1K BYTES
00047                    *         2 CLEARS 2K BYTES, 3 CLEARS 3K BYTES, 6 CLEARS 6K BYTES
00048                    *         CURSOR IS PLACED AT THE END OF THE CLEARED MEMORY SPACE
00049                    *
00050                    *
00051                    *
00052                    *
00053                    *
00054                    *
00056A 4000                     ORG     $4000
00057                    *             BEGINING OF PROGRAM :  STARTS AT $4005
00058          F878  A INCH     EQU     $F878
00059          6000  A VIEW     EQU     $6000     BEGINNING OF DISPLAY RAM
00060A 4000    0001  A TEMPO    RMB     1         COUNTER FOR THE CURRENT CHARACTER POSITION WITHIN A BLOCK (ONE OF 4)
00061A 4001    0002  A TEMP5    RMB     2
00062A 4003    0002  A CLRMEM   RMB     2         NUMBER OF BYTES TO CLEAR COMPARISON REGISTER
00063                    *
00064A 4005 7F 4000  A BEGIN    CLR     TEMPO     CLEAR ALL TEMPORARY STORAGE BYTES
00065A 4008 7F 4001  A          CLR     TEMP5
00066A 400B CE 6000  A          LDX     #VIEW     PUT DISPLAY LOCATION IN X REG
00067A 400E 86 FF    A CURINC   LDAA    #$FF      MAKE CURSOR FILL ENTIRE BLOCK
00068A 4010 A7 00    A          STAA    00,X      PUT CURSOR ON SCREEN
00069A 4012 BD F878  A INCH1    JSR     INCH      INPUT FROM TERMINAL
00070A 4015 81 57    A          CMPA    #$57      ASCII W ? FOR WHITE (BUFF)
00071A 4017 27 04 401D          BEQ     WAG       CHOICE WAS EITHER WHITE OR GREEN  DEPENDING ON THE
00072                    *            COLOR SET SELECT PIN
00073A 4019 81 47    A          CMPA    #$47      ASCII G? FOR GREEN
00074A 401B 26 04 4021          BNE     CYAN      NOT WHITE OR GREEN CHECK REST OF COLORS
00075A 401D 86 00    A WAG      LDAA    #$00      WHITE AND GREEN
00076A 401F 20 24 4045          BRA     MAIN      WHITE OR GREEN WAS CHOSEN NOW GO DIPLAY
00077A 4021 81 43    A CYAN     CMPA    #$43      ASCII C? FOR CYAN
00078A 4023 27 04 4029          BEQ     CAY       GO GET CYAN COLOR INFO IN ACC A IF COMPARE IS ZERO
00079A 4025 81 59    A          CMPA    #$59      ASCII Y? YELLOW
00080A 4027 26 04 402D          BNE     MAG       CHECK NEXT COLOR OR INSTRUCTION
00081A 4029 86 01    A CAY      LDAA    #$01      CYAN AND YELLOW
00082A 402B 20 18 4045          BRA     MAIN      C OR Y : NOW GO DISPLAY
00083A 402D 81 4D    A MAG      CMPA    #$4D      ASCII M? MAGENTA
00084A 402F 27 04 4035          BEQ     MAB
00085A 4031 81 42    A          CMPA    #$42      ASCII B? BLUE
00086A 4033 26 06 403B          BNE     ORG
00087A 4035 86 02    A MAB      LDAA    #$02      MAGENTA AND BLUE
00088A 4037 20 0C 4045          BRA     MAIN
00089A 4039 20 D7 4012 INCH4    BRA     INCH1     TO INCH INPUT TERMINAL INFO
00090A 403B 81 4F    A ORG      CMPA    #$4F      ASCII O? ORANGE
00091A 403D 27 04 4043          BEQ     OAR
00092A 403F 81 52    A          CMPA    #$52      ASCII R
00093A 4041 26 04 4047          BNE     START
00094A 4043 86 03    A OAR      LDAA    #$03      ORANGE AND RED INFO FOR VDG
00095A 4045 20 4E 4095 MAIN     BRA     MAIN1     A STEPPING STONE ALONG THE WAY TO KEEP RELATIVE CODING
00096A 4047 81 53    A START    CMPA    #$53      ASCII S ? GO TO BEGINNING OF PROGRAM
00097A 4049 26 06 4051          BNE     NEGOLD
00098A 404B 86 00    A          LDAA    #$00      CLEAR CURSOR
00099A 404D A7 00    A          STAA    00,X      STORE CURSOR
00100A 404F 20 B4 4005          BRA     BEGIN     TO BEGINNING OF PROGRAM
00101A 4051 81 4E    A NEGOLD   CMPA    #$4E      ASCII N NEGATIVE DIRECTION AND  LEAVE OLD INFO
00102A 4053 26 0F 4064          BNE     END
00103A 4055 F6 4001  A          LDAB    TEMP5
00104A 4058 E7 00    A          STAB    00,X
00105A 405A 09                  DEX
00106A 405B E6 00    A          LDAB    00,X
00107A 405D F7 4001  A          STAB    TEMP5     UPDATE TEMPORARY REG
00108A 4060 20 AC 400E          BRA     CURINC    GO DISPLAY CURSOR AND GET INPUT
00109A 4062 20 D5 4039 INCH3    BRA     INCH4
00110A 4064 81 45    A END      CMPA    #$45      ASCII E; END PROGRAM
00111A 4066 27 04 406C          BEQ     MONIT     USE SOFTWARE INT IF = E
00112A 4068 81 46    A          CMPA    #$46      ASCII  F; FINISH PROGRAM: SAME  THING
00113A 406A 26 01 406D          BNE     DECLER    CHECK NEXT INSTRUCTION
00114A 406C 3F         MONIT    SWI               GO BACK TO MONITOR
00115A 406D 81 44    A DECLER   CMPA    #$44      ASCII D DECREMENT ONE LOCATION & CLEAR LAST LOCATION
00117A 406F 26 0F 4080          BNE     INCZ      GO TO NEXT INSTRUCTION
00118A 4071 86 00    A          LDAA    #$00      CLEAR CURSOR
```

```
00219A 412E 20 D3 4103 CURINO   BRA     CURIN1
00220A 4130 81 03    A CLEAR    CMPA    #$03      EXT OR CONTROL C
00221A 4132 26 D1 4105          BNE     INCH9     IGNORE ERRONEOUS INPUT CHAR
00222A 4134 BD F878  A          JSR     INCH      IF GOOD THEN CHECK HOW MUCH MEMORY TO CLEAR
00223A 4137 81 35    A          CMPA    #$35      INPUT AN ASCII 5 ?
00224A 4139 26 08 4143          BNE     ONEK      NO? GO SEE IF ONE KILO BYTE
00225A 413B CE 01FF  A          LDX     #$01FF    512 BYTES
00226A 413E FF 4003  A          STX     CLRMEM    PUT IN COMPARISON REG
00227A 4141 20 2E 4171          BRA     MEMCLR    GO CLEAR MEMORY
00228A 4143 81 31    A ONEK     CMPA    #$31      INPUT ASCII 1 ?
00229A 4145 26 08 414F          BNE     TWOK      IF NOT CHECK IF WANT 2 KILO BYTES OF MEMORY CLEARED
00230A 4147 CE 03FF  A          LDX     #$03FF    1K BYTES
00231A 414A FF 4003  A          STX     CLRMEM
00232A 414D 20 22 4171          BRA     MEMCLR    GO CLEAR
00233A 414F 81 32    A TWOK     CMPA    #$32      INPUT AN ASCII 2?
00234A 4151 26 08 415B          BNE     THREEK    NO. GO CHECK IF 3 IS INPUT
00235A 4153 CE 07FF  A          LDX     #$07FF    2K BYTES
00236A 4156 FF 4003  A          STX     CLRMEM    STORE IN COMPARISON REG FOR INDEX REG
00237A 4159 20 16 4171          BRA     MEMCLR    GO CLEAR
00239A 415B 81 33    A THREEK   CMPA    #$33      INPUT ASCII 3?
00240A 415D 26 08 4167          BNE     SIXK      NO , THEN GO CHECK IF 6K DESIRED TO CLEAR
00241A 415F CE 0BFF  A          LDX     #$0BFF    3K BYTES
00242A 4162 FF 4003  A          STX     CLRMEM
00243A 4165 20 0A 4171          BRA     MEMCLR    GO CLEAR
00244A 4167 81 36    A SIXK     CMPA    #$36      INPUT AN ASCII 6?
00245A 4169 26 9A 4105          BNE     INCH9     NO.  THEN IGNORE ERRONEOUS INPUT AND GO GET NEW COMMAND
00246A 416B CE 17FF  A          LDX     #$17FF    6K BYTES
00247A 416E FF 4003  A          STX     CLRMEM    STORE IN COMPARISON REG
00248A 4171 CE 6000  A MEMCLR   LDX     #VIEW     BEGINNING OF SCREEN
00249A 4174 6F 00    A CLEAN    CLR     00,X      CLEAR MEMORY LOCATION
00250A 4176 08                  INX               NEXT LOCATION
00251A 4177 FF 4001  A          STX     TEMP5     SAVE CURRENT LOCATION'S ADDRESS
00252A 417A FE 4003  A          LDX     CLRMEM    GET MEMORY COUNTER, THRU CLEARING?
00253A 417D 26 05 4184          BNE     CONT
00254A 417F FE 4001  A          LDX     TEMP5
00255A 4182 20 AA 412E          BRA     CURINO    YES
00256A 4184 09         CONT     DEX               DECREMENT MEMORY COUNTER
00257A 4185 FF 4003  A          STX     CLRMEM    STORE THE COUNTER NUMBER
00258A 4188 FE 4001  A          LDX     TEMP5     GET CURRENT ADDRESS
00259A 418B 20 E7 4174          BRA     CLEAN     NO
00260                           END
TOTAL ERRORS 00000
```

```
CROSS REFERENCE TABLE

40F6 AGAIN  00191*00197
4005 BEGIN  00064*00100
4029 CAY    00078 00081*
4174 CLEAN  00249*00259
4130 CLEAR  00213 00220*
4003 CLRMEM 00062*00226 00231 00236 00242 00247 00252 00257
4184 CONT   00253 00256*
412E CURINO 00219*00255
4103 CURIN1 00198*00207 00219
40E5 CURIN2 00180*00193 00198
40B5 CURIN3 00150*00180
407E CURIN4 00124*00133 00150
400E CURINC 00067*00108 00124
4021 CYAN   00074 00077*
40E9 DCJMP1 00126 00182*
40EB DECJMP 00182 00186*
406D DECLER 00113 00115*
4064 END    00102 00110*
F878 INCH   00058*00069 00222
4012 INCH1  00069*00089
4093 INCH2  00134*00160
4062 INCH3  00109*00134 00151
4039 INCH4  00089*00109
40B7 INCH7  00151*00181
40E7 INCH8  00181*00199
4105 INCH9  00199*00221 00245
4107 INCOLD 00187 00200*
4080 INCZ   00117 00125*
411F LOLD   00201 00212*
4035 MAB    00084 00087*
402D MAG    00080 00083*
4045 MAIN   00076 00082 00088 00095*
4095 MAIN1  00095 00135*
4171 MEMCLR 00227 00232 00237 00243 00248*
406C MONIT  00111 00114*
4051 NEGOLD 00097 00101*
4043 OAR    00091 00094*
4143 ONEK   00224 00228*
403B ORG    00086 00090*
4112 PLUS   00205*00211
40B9 SHIFT2 00141 00152*
40CA SHIFT4 00139 00161*
40D4 SHIFT6 00137 00168*
4167 SIXK   00240 00244*
4047 START  00093 00096*
40BF STORE  00156*00167 00179
4000 TEMPO  00060*00064 00123 00132 00135 00142 00159
4001 TEMP5  00061*00065 00103 00107 00122 00131 00148 00169 00188 00195 00202 00209 00214 00218 00251 00254 00258
415B THREEK 00234 00239*
414F TWOK   00229 00233*
6000 VIEW   00059*00066 00248
401D WAG    00071 00075*
```

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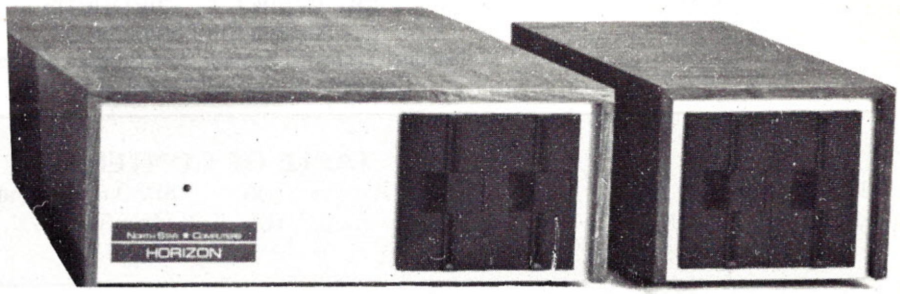

The NORTH STAR HORIZON® is a price-performance leader in S-100 systems. It features a 4 MHz CPU board and double-density disk controller board. All Horizons* now come with two serial RS232C ports, a parallel port, all 12 edge connectors, and an interface cable for connection to an external drive. Horizons are available as single-drive units (Horizon 1) or dual-drive units (Horizon 2). Drives can be double density or double-sided (quad density). A Horizon 2 with two external quad drives gives the user 1.4 megabytes of on-line storage. The Horizon comes with a DOS and North Star Extended Disk BASIC. A CP/M operating system is only $129.

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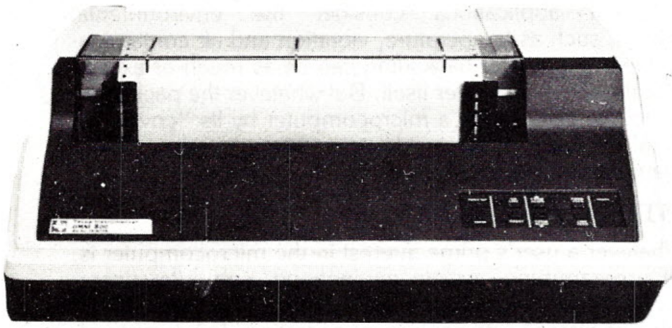

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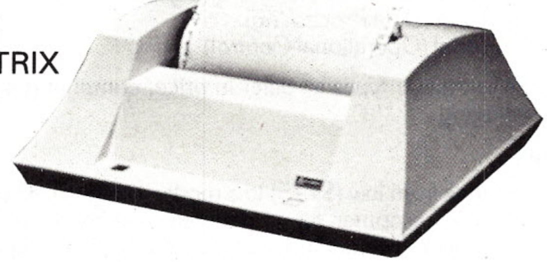

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TABLE OF CONTENTS

MICROCOMPUTERS

In a previous discussion on microprocessors, a conceptive viewpoint stressed was "a microprocessor is but one component of the microcomputer, whereas the microcomputer as a whole may be considered a processor." Therefore a microprocessor-based system that would include the functional components such as those depicted in Figure 133 would be classified as a microcomputer system.

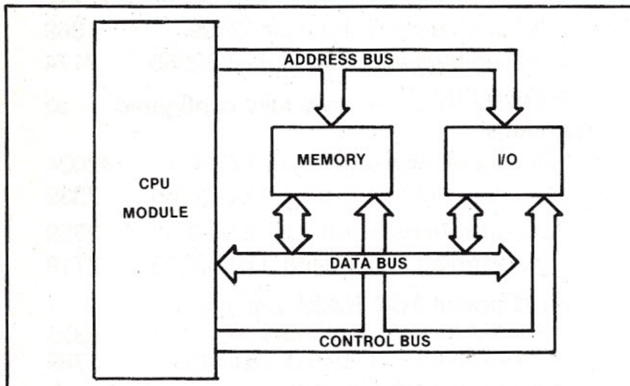

Figure 133. Typical Computer System Block Diagram

Microcomputers have been more or less classified into three categories:

1. Personal (consumer, tutorial and game types)
2. Business (Data Processing)
3. Industrial (Operational Control)

These computer types all differ in price, computing power and packaging.

Price

Prices range from low ($175) to a moderate high ($10,000). The personal computer types generally are found to vary from low to low end medium bracket, the business types at the high end and the industrial somewhere around the medium bracket. In any event, price is influenced by the amount and type of peripheral equipment required. This in turn brings forth interfacing requirements and costs.

Computing Power

Computing power differs among the computers, as personal and business types utilize 8- and 16-bit microprocessors, whereas industrial systems incorporate 1- to 4-bit word microprocessors. Consider also the large mainframe computers working with 32- to 64-bit words.

Packaging

The physical condition and enclosement of the three basic types differ in most respects. These have to do with price, aesthetics, and environment.

The single board type may be simply presented on a single PC board along with a data entry keyboard and display readout. The selection of enclosure is left up to the user. The KIM-1 manufactured by MOS Technology Division of Commodore is offered in this manner. Rockwell's AIM-65 is also offered in the same manner. This PC board is larger since it incorporates a terminal style keyboard, a thermal printer and a 20-character display unit all together.

Several computers are now being offered in attractive molded plastic enclosures. Lately the trend in packaging of personal and light business types of microcomputers is to incorporate the microcomputer, CRT terminal, and floppy disk mechanism into the same enclosure. The new Heathkit H-89 is a prime example of this type of packaging.

Industrial applications consider the environmental elements, such as temperature, vibration and air contamination. Here the cost of packaging can be as much or exceed that of the microcomputer itself. But whatever the packaging may be, we can't judge a microcomputer by its "cover." A general overview of the inside operation is required before judgement can be passed.

SYSTEM COMPONENTS

Whatever a user's prime interest in the microcomputer is, be it programming, system engineering, computer operation, technical maintenance and service, the user should familiarize himself with equipment operation. This is generally accommodated by the use of functional block diagrams such as those presented throughout this tutorial.

In addition, as we proceed into system operation for the first time, it appears that so much is going on that we will never be able to cope with the operation. However, as the subject material is probed repeatedly, understanding makes its emergence.

As we indicated before, the microprocessor (CPU) is the heart of the system. In order to compose a computer system, support circuitry is required. In addition to the instruction set memory (ROM), there is also a need for working data storage (RAM), assuming the microprocessor provides the necessary timing and control signals, provisions are also required for input/output data instructions and addresses. Ad-

dress, control and data buses serve as communicative paths internally within the CPU as well as externally tying the various support circuitry and peripheral equipments together. Encoders/decoders are required, since information fed into and out of the computer is not in machine language form.

Quite often it is necessary to break in (interrupt) on the current program flow, such that the flow may be resumed from the point at a later time. This is referred to as an interrupt and quite often originates from the peripheral equipment.

Familiarity with the microcomputer begins with the CPU and/OR microprocessor. Although newer processors than Intel's 8080A are available, we shall use the 8080A because it has been the standard of the industry for quite some time. Knowledge of the 8080A also provides a very good background for the investigation of some of the more recent 8-and 16-bit processors.

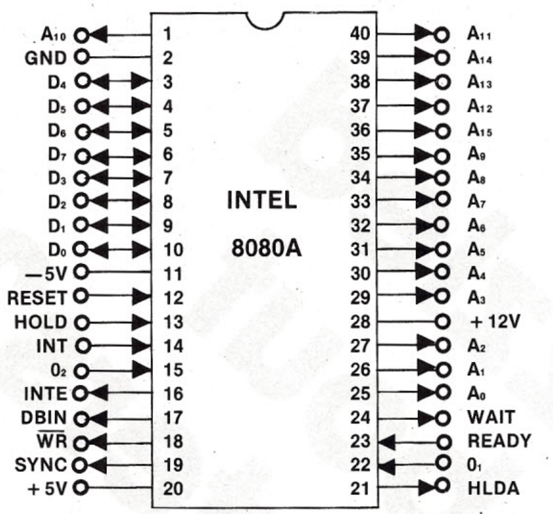

Figure 134.

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8080 FUNCTIONAL PIN DEFINITION

The following describes the function of all of the 8080A I/O pins. Several of the descriptions refer to internal timing periods.

A_{15}-A_0 (Output Three-State)

Address Bus: the address bus provides the address to memory (up to 64K 8-bit words) or denotes the I/O device number for up to 256 input and 256 output devices. A_0 is the least significant address bit.

D_7-D_0 (Input/Output Three-State)

Data Bus: the data bus provides bi-directional communication between the CPU, memory, and I/O devices for instructions and data transfers. Also, during the first clock cycle of each machine cycle, the 8080A outputs a status word on the data bus that describes the current machine cycle. D_0 is the least significant bit.

SYNC (Output)

Synchronizing Signal: the SYNC pin provides a signal to indicate the beginning of each machine cycle.

DBIN (Output)

Data Bus In: The DBIN signal indicates to external circuits that the data bus is in the input mode. The signal should be used to enable the gating of data onto the 8080A data bus from memory or I/O.

READY (Input)

Ready: The READY input indicates to the 8080A that valid memory or input data is available on the 8080A data bus. This signal is used to synchronize the CPU with slower memory or I/O devices. If the 8080A sends an address out and does not receive a READY input, the 8080A will enter a WAIT state for as long as the READY line is low. READY can also be used to single step the CPU.

WAIT (Output)

WAIT: the WAIT signal acknowledges that the CPU is in a WAIT state.

$\overline{WR}$ (Output)

Write: the $\overline{WR}$ signal is used for memory WRITE or I/O output control. The data on the data bus is stable while the WR signal is active low ($\overline{WR} = 0$).

HOLD (Input)

HOLD: the HOLD signal requests the CPU to enter the HOLD state. The HOLD state allows an external device to gain control of the 8080A address and data bus as soon as the 8080A has completed its use of these buses for the current machine cycle. It is recognized under the following conditions:

- the CPU is in the HALT state.
- the CPU is in the T2 or TW state and the READY signal is active.

As a result of entering the HOLD state the CPU ADDRESS BUS (A_{15}-A_0) and DATA BUS (D_7-D_0) will be in their high impedance state. The CPU acknowledges its state with the HOLD ACKNOWLEDGE (HLDA) pin.

HLDA (Output)

HOLD ACKNOWLEDGE: the HLDA signal appears in response to the HOLD signal and indicates that the data and address bus will go to the high impedance state. The HLDA signal begins at:

- T3 for READ memory or input.

  The Clock Period following T3 for WRITE memory or OUTPUT operation.

In either case, the HLDA signal appears after the rising edge of 01 and high impedance occurs after the rising edge of 02.

INTE (Output)

INTERRUPT ENABLE: indicates the content of the internal interrupt enable flip/flop. This flip/flop may be set or reset by the Enable and Disable Interrupt instructions and inhibits interrupts from being accepted by the CPU when it is reset. It is automatically reset (disabling further interrupts) at time T1 of the instruction fetch cycle (m1) when an interrupt is accepted and is also reset by the RESET signal.

INT (Input)

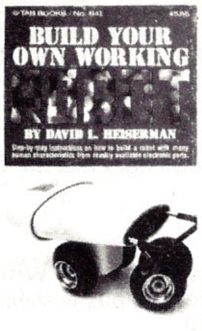
INTERRUPT REQUEST: the CPU recognizes an interrupt request on this line at the end of the current instruction or while halted. If the CPU is in the HOLD state or if the Interrupt Enable flip/flop is reset, it will not honor the request.

RESET (Input) 1

RESET: while the RESET signal is activated,the content of the program counter is cleared. After RESET, the program will start at location 0 in memory. The INTE and HLDA flip/flops are also reset. Note that the flags, accumulator, stack pointer, and registers are not cleared.

Vss	Ground Reference
VDD	$+12 \pm 5\%$ Volts
Vcc	$+\ 5 \pm 5\%$ Volts
VBB	$-\ 5 \pm 5\%$ Volts (substrate bias)

01, 02 are two externally supplied clock phases (non TTL compatible).



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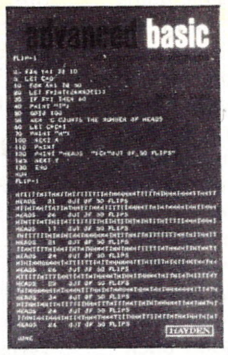

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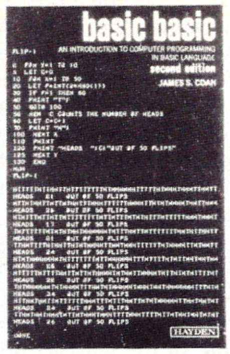

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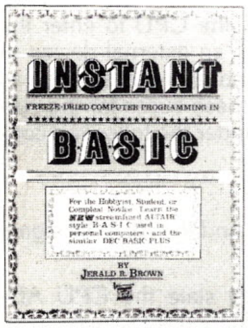

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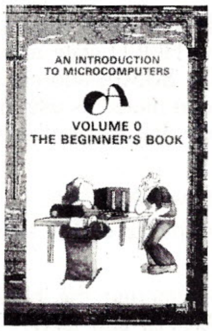

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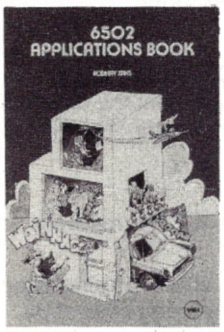

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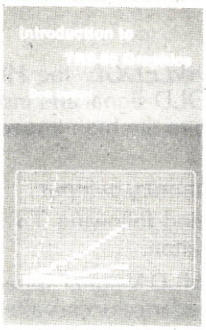

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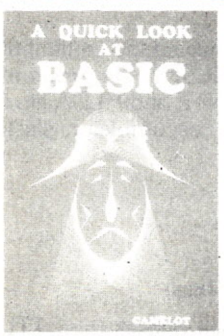

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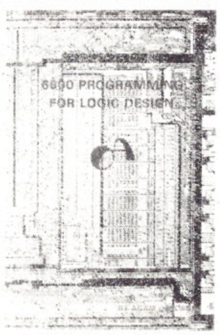

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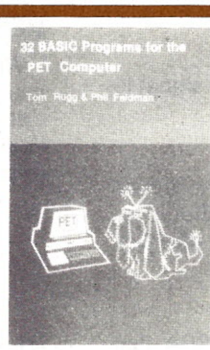

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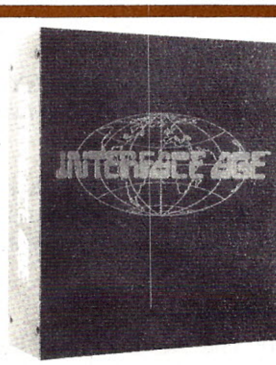

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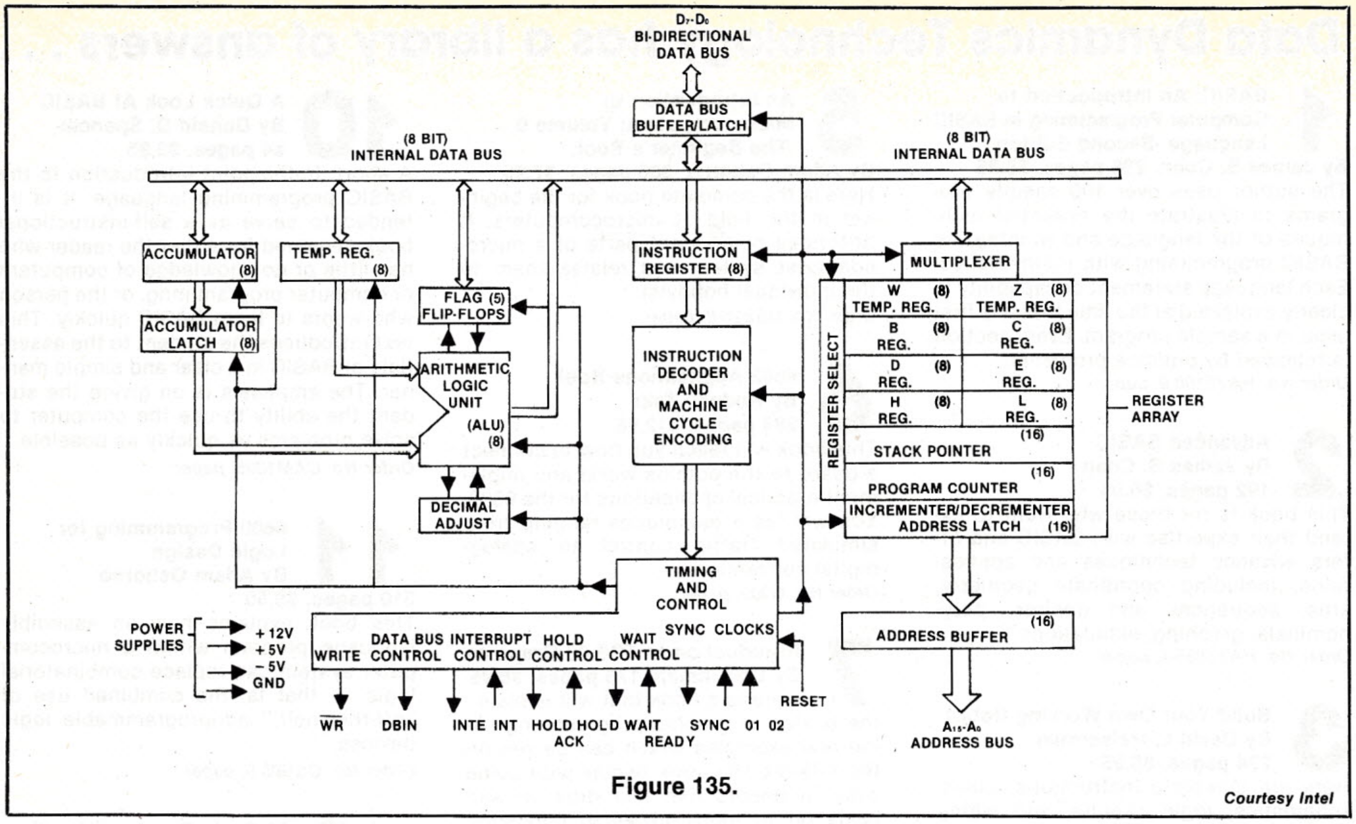

Figure 135.

Courtesy Intel

Figure 135 displays the pin definitions of the 8080A CPU and Figure 136 associates these definitions with the microcomputer itself.

The CPU ties the whole system together by controlling the operations carried out by other components of the system. Instructions are fetched from memory, contents (in binary form) decoded and executed by the CPU. It is also the CPU that responds to external control signals (interrupt and wait) from the peripherals.

Input ports enable the computer to *receive* information from outside equipment and output ports, as the name implies, outputs the processed information to external peripheral equipment.

The following outline may be considered basic to most computers:

1. Clock is the reference for all processor activity.
2. Fetch and execution of an instruction is called an Instruction Cycle.
3. Instruction Fetch:
   Memory Read or Write, CPU operation or I/O activity
4. Memory Read
   Data read into CPU from memory
5. Memory Write
   Data written into memory

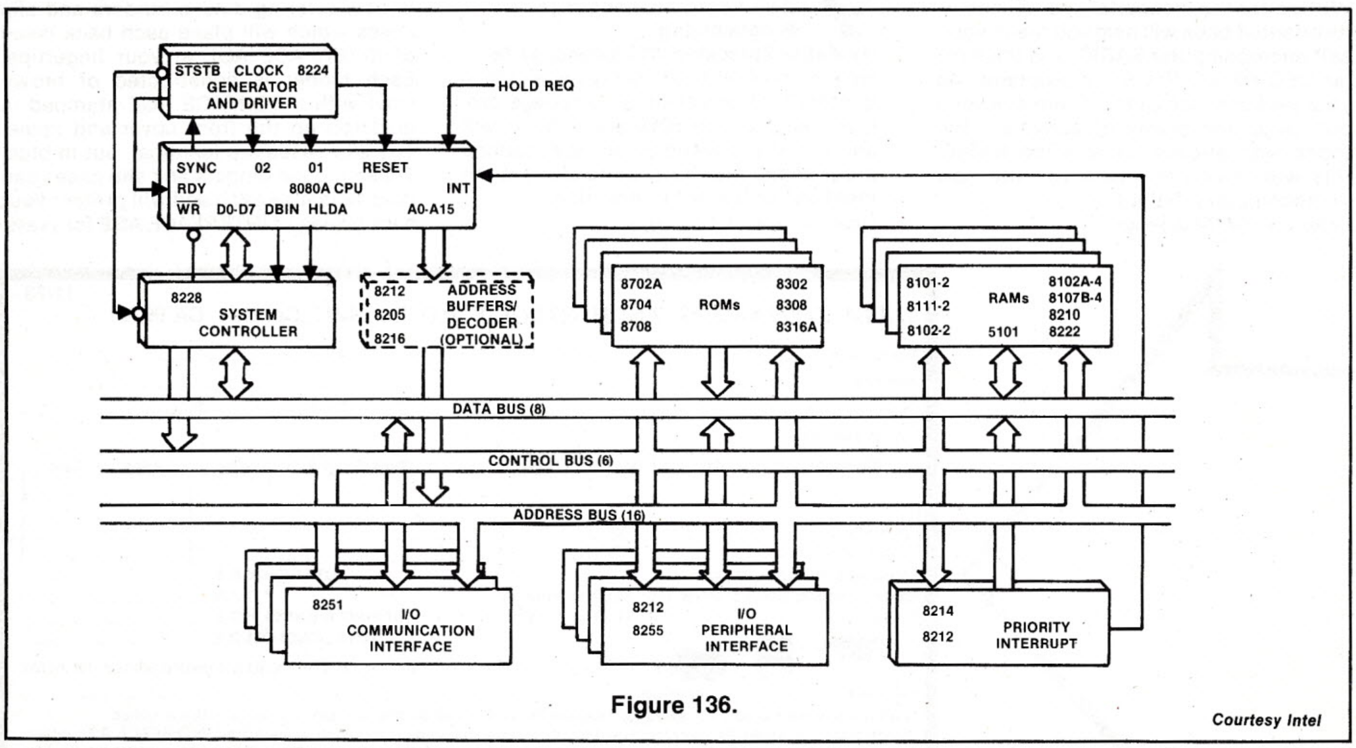

Figure 136.

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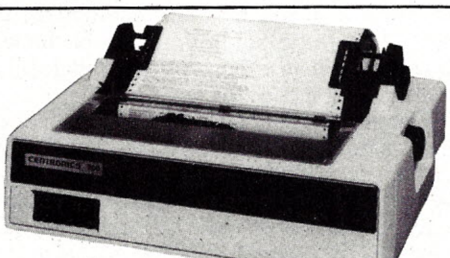

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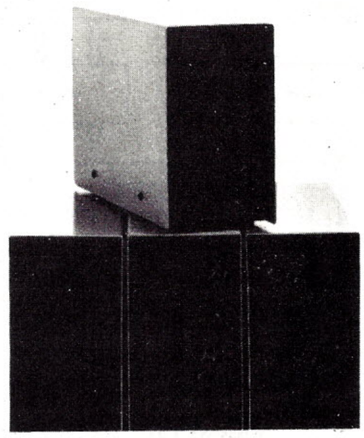

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9. Hold
   Enables Direct Memory Access

THE 6502 MICROPROCESSOR

Figure 137 displays the block diagram of the MOS KIM-1 single board microcomputer. The KIM-1 utilizes the 6502 8-bit microprocessor.

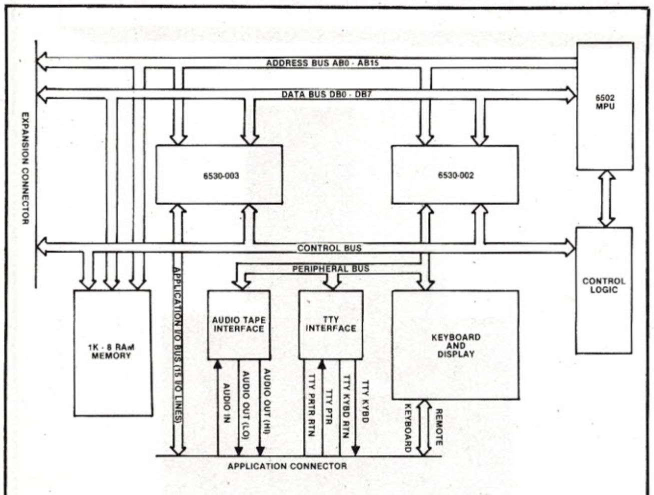

Figure 137.

Figure 138 displays the block diagram of Rockwell's single board AIM-65 microcomputer that also utilizes the 6502 processor. The AIM-65 incorporates a printer, 20-character readout display and terminal type keyboard.

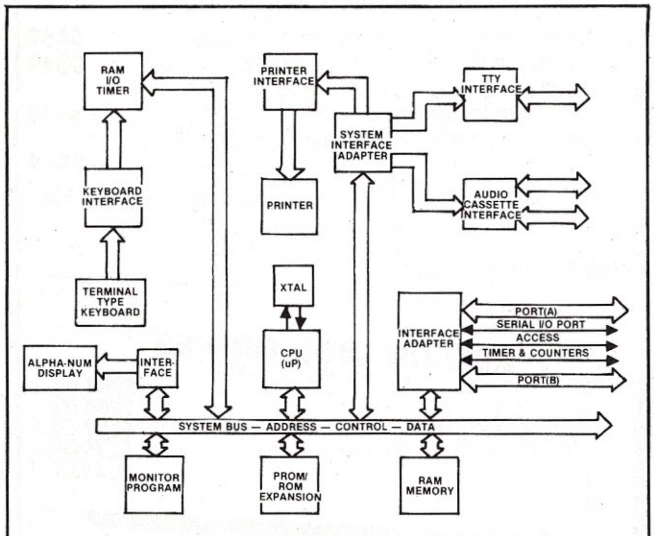

Figure 138.

CONCLUSION

This series has presented an overview of the fundamental principles utilized in digital processing and control. Due to space and time limitations, some of the material was covered from a general viewpoint. It is recommended that the individual who wishes to pursue the subject matter to greater depth inquire into an accredited home study course that implements hardware, such as those offered by National Technical Schools.

Most colleges offer computer education courses, and a wealth of books have been published on the subject. At present, NTS and INTERFACE AGE are exploring the possibility of putting this series into book form.

This tutorial concludes the NTS mini-series of Basic Electronics with the hope that the series has brought about an illuminative overview of the basic principles involved. It has only been 100 years since Thomas Edison invented the light bulb, illuminating the way for the gigantic advances of electrical applications during this century.☐

SUMMARY/QUIZ TUTORIAL #9

1. A 1-bit microprocessor would be generally utilized in: (A) a business type microcomputer; (B) a personal type microcomputer; (C) a 64-bit word computer; (D) a data processing computer; (E) an industrial systems application.
2. An interrupt is defined as: (A) a break in the continuity of a running computer program; (B) a WAIT; (C) an encoder; (D) a Hold; (E) a Reset.
3. Which of the following is classified as both input and output: (A) address bus; (B) data bus; (C) control bus; (D) DBIN signal; (E) SYNC signal.
4. An instruction fetch is best described by: (A) WAIT; (B) Memory Read; (C) Hold; (D) I/O activity, Memory Write, CPU operation and Memory Read; (E) Memory Write.
5. The address and data buses are given to external device control as a result of: (A) the Hold state; (B) the Ready state; (C) HLDA; (D) WR; (E) D_0.
6. Which of the following is cleared by the Reset signal: (A) accumulator; (B) stack pointer; (C) program counter, interrupt enable and hold acknowledge flip flops; (D) instruction register; (E) flag flip flops.
7. Mode status (input/output) of the data bus is indicated to the peripheral equipments by: (A) A_3; (B) D_3; (C) the Hold signal; (D) the DBIN signal; (E) the INTE signal.
8. The beginning of each machine cycle is confirmed by: (A) the WAIT signal; (B) the SYNC signal; (C) the HLDA signal; (D) the WR signal; (E) the READY signal.
9. Direct memory access is enabled by the: (A) instruction cycle; (B) WAIT signal; (C) the HOLD signal; (D) the SYNC signal; (E) RESET signal.
10. The source of the SYNC signal is: (A) the ALU; (B) system controller; (C) priority interrupt; (D) clock generator and driver; (E) timing and control section of the CPU.
11. Fetch and execution of an instruction is called: (A) a memory cycle; (B) an interrupt; (C) an instruction cycle; (D) an instruction set; (E) instruction fetch.
12. Accesses that enable the computer to receive and output information to and from external equipments are generally referred to as: (A) interfaces; (B) peripherals; (C) channels; (D) input and output ports; (E) processors.
13. As a result of the CPU going into a HOLD state, the address and data buses go into a: (A) WAIT state; (B) high impedance state; (C) high logical state; (D) indefined state; (E) low logical state.
14. Please rate this unit of the NTS/INTERFACE AGE mini-series. (A) Excellent; (B) Good; (C) Average; (D) Poor.
15. Would you like to see series of this type in the magazine in the future? (A) Yes; (B) No.

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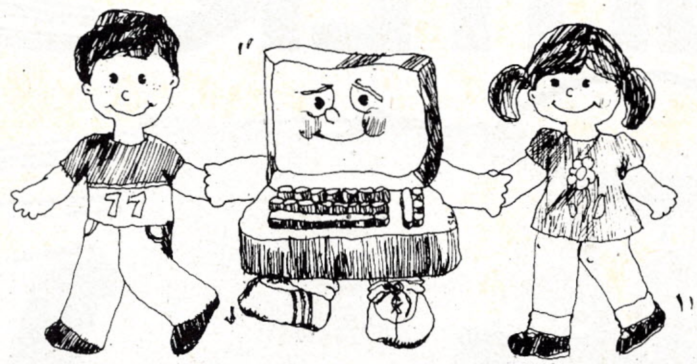

By Bob Albrecht

NUMBER PATTERNS

An elementary school exercise: explore a number pattern. The student is shown the first few numbers in the pattern, then asked to guess the next number or the next few numbers in the pattern. Number patterns are favorite tools of the *grand inquisitors* who construct IQ tests. Students with "high IQs" come up with the numbers that the test constructors have in mind. Creative students might do something entirely different and, of course, be tagged with lower IQs.

So let's begin with some very simple number patterns. In these patterns, each number, after the first, is obtained by doing something to the previous number. For example,

(1) 1, 2, 3, __, __, etc.
The first number is 1. After the first number, each new number is obtained by adding 1 to the preceding number.

(2) 2, 4, 6, __, __, etc.
The first number is 2. Each successive number is obtained by adding 2 to the preceding number.

(3) 1, 3, 5, __, __, etc.
The first number is 1. Each successive number is obtained by adding 2 to the preceding number.

(4) 2, 5, 8, 11, 14, ____, ____, etc.
The first number is 2. Each successive number is obtained by adding 3 to the previous number.

The above patterns are simple *sequences* of numbers. The first number in the sequence is given. Then, each successive number in the sequence is obtained by adding something (always the *same* something) to the preceding number.

It is very easy to program. Our first program works like this:

(1) The TRS-80 asks for the first number in the pattern and the number to be added to get the next number. The teacher, or the student, enters these numbers.

(2) The TRS-80 then clears the screen and shows the first number in the pattern.

(3) To see the next number in the pattern, press the space bar. To quit watching *this* pattern, press the Q key.

(4) If you press the Q key, the TRS-80 will return to step (1), above.

That's it. Here is the program.

```
100 REM***NUMBER PATTERNS #1
200 REM***ASK FOR FIRST NUMBER(S) AND ADD-ON NUMBER (A)
210 CLS
220 INPUT "FIRST NUMBER" ; S
230 INPUT "ADD-ON NUMBER" ; A
240 CLS
300 REM***SHOW THE 'LATEST' NUMBER, S
310 PRINT S
400 REM***WAIT FOR KEY PRESS, 'SPACE' OR 'Q'
410 KEY$=INKEY$ : IF KEY$= "" THEN 410
420 IF KEY$ = " " THEN 510
430 IF KEY$ = 'Q' THEN 210 ELSE 410
500 REM***COMPUTE NEXT NUMBER IN PATTERN
510 S = S + A
520 GOTO 310
999 END
```

Please check out lines 410 through 430 in this program. Line 410 tells the TRS-80 to wait for someone to press a key. If someone *does* press a key, the value of the key becomes the value of the string variable KEY$. If *no* key is pressed, the value of KEY$ is *empty*. So (aha!) if the value of KEY$ is empty, then KEY$="" is TRUE. The TRS-80 goes right back to line 410. . .and scans the keyboard again.

Now suppose that our eager young number pattern explorer presses the space bar. In this case, the value of KEY$ becomes a space. So, KEY$="" is FALSE and the TRS-80 moves on to line 420, where KEY$=" " is TRUE.

Line 420 senses that the space bar has, indeed, been pressed (KEY$=" " is TRUE). Our ever-obedient TRS-80 goes to line 510, computes a new value of S and. . .*you* can figure that out.

Time passes. The explorer has explored. As always with explorers, she learns about this region of numbers, tires of the terrain and presses the Q key. The TRS-80 moves from line 410 to line 420 to line 210. Why? Well, if we get seven (7) requests to explain *why,* we will!

We have provided for this contingency. If you press a key *other than* the space bar or the Q key, line 430 will send the TRS-80 right back to line 410, thus giving you another chance. This happens because of the ELSE 410 clause, which takes over when the condition KEY$ = "Q" is FALSE.

A MODEST MODIFICATION

If you are a math teacher, or a child of just the right age or an adult with a long memory, perhaps you remember *geometric sequences.* (Maybe they were called *geometric progressions.*)

(5) 1, 10, 100, 1000, ______, ______, etc.
The first number is 1. After the first number each new number is obtained by multiplying the preceding number by 10.

(6) 1, 2, 4, 8, __, __, etc.
The first number is 1. After the first number each new number is obtained by multiplying the preceding number by 2.

(7) 3, 6, 12, 24, ____, ____, etc.
The first number is 3. After the first number each new number is obtained by multiplying the preceding number by 2.

The *structure* is the same as before. We start with a number. We do something to that number to get the next number. We continue doing the same thing to each *old* number to get a *new* number.

Math has a bunch of fancy words to describe this idea. *Recursion* is one of these words. Sounds formidable (another fancy word!), doesn't it!

Forget the fancy math words. Kids can learn *anything,* if you don't bury the knowledge in words.

And so, let's make a small change in our NUMBER PATTERNS #1 program. Instead of adding, let's multiply. Make the following changes.

```
230 INPUT "MULTIPLY NUMBER" ; A
510 S = S*A
```

Ah! The beauty of computers. So easy to change from one (related) idea to another (related) idea. So easy to show the basic structure. So easy to create a small program with which to explore a universe!

SMALL CHANGES

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The Pascal Notebook
Chapter 6

By Henry Davis, Associate Editor

By now you have seen the majority of Pascal either formally or informally. Rather than continue with the Pascal compiler, let's take the opportunity to review where we are and where we are headed.

Chapter 1 presented a brief history of Pascal along with the justification of the language design. It discussed Niklaus Wirth's use of language theory, and syntax analysis during the design of Pascal. The basic vocabulary of Pascal (keywords and user defined identifiers) was also covered, along with the rules for forming sentences (productions), and "syntax versus semantics."

One of the most important concepts is the use of parsing and sentence generation. Two fundamental procedures are derived from these techniques: 1) the use of syntax diagrams to determine the structures which should be used in a program, and 2) the use of a programmed form of the syntax diagrams by the computer to check a Pascal program for syntactic correctness.

The parsing scheme used in Pascal compilers is based on knowing the present state of the parsing algorithm and the next symbol. This algorithm is known as one-symbol-look ahead without backtracking; the motivation is ease of implementation and efficiency. In order to ensure that backtracking is explicitly prohibited, rule R1 is introduced. It simply says that two different Pascal statements cannot start with the same symbol.

Chapter 2 demonstrated that while no semantics are explicit in a grammar, implied semantics arise due to the order in which items are encountered when syntax is used as a passing tool. The fundamental point here is that equivalent grammars do not generally have the same meaning (semantics).

Mathematics has often been called a universal language for scientists because it transcends the cultural and linguistic barriers of natural language. Programming languages have a special piece of mathematics used to convey the syntax to people. BNF or Backus-Nau Form is a symbolism based on the linguistic theory of Noam Chomsky, and was first used to define Algol-60. Because BNF is used to describe languages, it is known as a meta-language and the symbols as meta-symbols. Angle brackets define an entity of the language under question. For example:

A: =<a>

defines a thing called an "A" as an "a". Alternatives in a definition are indicated by a vertical bar, so:

A: =<a>|<b>

defines an "A" as an "a" or a "b".

The previous two examples utilized a symbol indicating definition, the ":=", which is a fundamental concept in BNF. Strictly speaking, these four symbols comprise the symbols of BNF. In order to make the language definition easier and more explicit, repetition is indicated by curly braces { }, which means from zero to as many repetitions as is necessary.

Pascal itself is a relatively small language in terms of numbers of constructs, but the power of the language is substantial. What follows is a brief review of the programming aspects of Pascal.

For more than 20 years an on-going battle over programming languages has been fought. Each language has its own merits and deficits and has perished or survived based loosely on those points. Pascal brings no new concepts to the picture, but what it does have is a simple, clean, and easy to understand syntax. It is a block structured language that supports all control statements generally viewed as basic to any programming language and adds facilities to declare new data types.

If there is nothing new, why use it? More than anything else, Pascal brings a philosophy or methodology to programming. This methodology is based on a discipline of constructing and formulating algorithms in a systematic manner based on levels of abstraction. By dealing with problems on a high level of abstraction, a top-down approach breaks the problems on each level into sub-problems. Each sub-problem can be logically designed and the reliability tested so that the end program is well understood.

The logical and concise representation of an algorithm in any programming language is predicated on a logical and concise programming language. Earlier languages like FORTRAN and BASIC have mutated from a base requirement into a hodgepodge. Pascal has been designed with good programming style as the end goal.

Let's look at some of the control structures available to you. The most basic of all control structures is the sequence. Most computers are sequential, thus one operation is performed, then the next and so on. Because we often deal with a group of operations (or statements) it is convenient to allow an explicit grouping of statements. If S1, S2, . . ., SN are statements then we can write the compound statement (statement with grouping) as:

begin S1; S2; . . .; SN END

→ S1 → S2 → . . . → SN →

The semicolon causes each subsequent statement to be performed only after the preceding one is complete, and is known as a sequencing operator. The begin and end symbols are sort of parenthesis for statements. In order to further set off command statements, begin-end pairs are often

"prettyprinted" with an indentation so that there is a visual grouping of the program elements. Figure 11 illustrates a typical Pascal program with the BEGIN-END indentations for visual grouping.

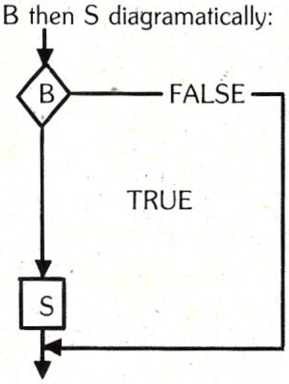
```
Begin q: = 0; r: = x;
    WHILE r — y DO
    BEGIN
      r: = r—y; q: = q + 1
      END;

END;
```

Figure 11. Pascal program to perform integer division of two natural numbers.

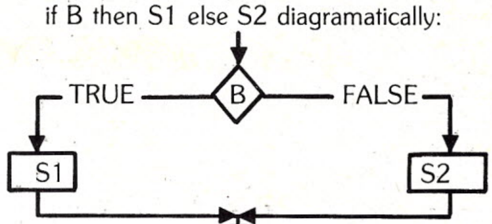
Conditional statements are the basic building blocks of program control. The English language uses implication as a means of expressing alternatives. Pascal follows suit with the statement:

if B then S diagramatically:



and

if B then S1 else S2 diagramatically:



In the first case, S is executed only if B is true; otherwise the statement S is skipped. The second case is a more generalized form of the first; S1 is executed only if B is true and S2 is executed otherwise. The statements S, S1 and S2 may be compound statements (grouped by a BEGIN-END pair) or be empty (simply the BEGIN-END pair). Figure 12 depicts the forms of the conditional actual usage.

```
BEGIN z:0 0; u: = x;v: = y;
    WHILE u≠o DO
    BEGIN
      IF odd(u) THEN z: = z + v;
      u: = udiv2; v: = 2*v
    END;
END;
  2a Multiplication of two natural numbers
BEGIN a: = x; b: = y;
  WHILE a≠b DO
  IF a>b THEN a: = a—b ELSE b: = b—a
END;
2b Computation of the greatest common divisor
```

Figure 12a.

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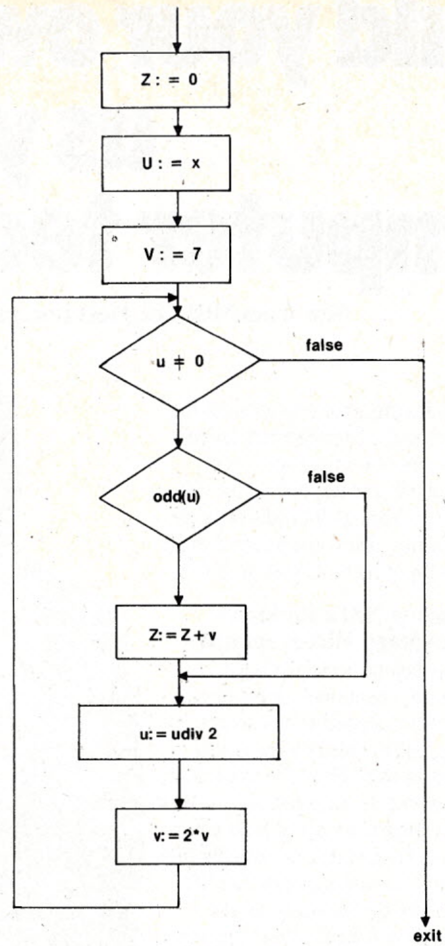

Figure 12b.

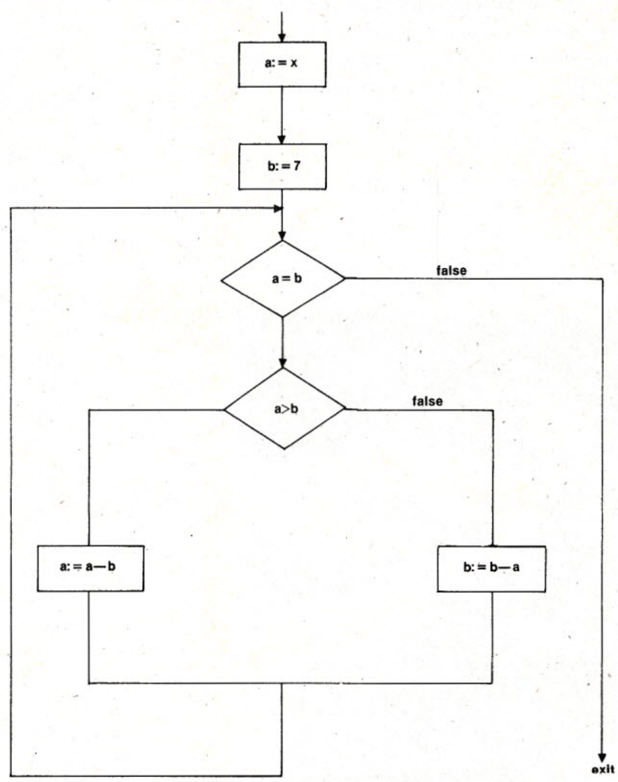

Figure 12c.

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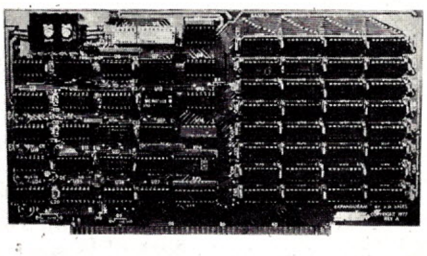

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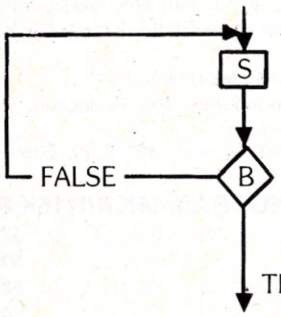
Computer programs, like recipes, require some form of repetitive statement. We often say or write statements like "beat until fluffy," or "while the light is red, wait at the corner."

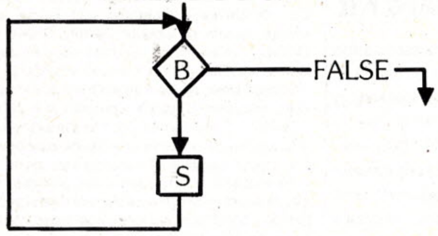
Because the aim of Pascal is to be like a natural language, these two constructs are included to control interaction or repetition. The REPEAT statement causes the statement associated with it to be executed at least once.

REPEAT S UNTIL B:



To indicate zero or more repetitions of a statement use the WHILE statement:

WHILE B DO S:



The difference between the two forms may at first glance seem to be trivial, but various algorithms lend themselves to one form rather than the other. For example, many mathematical algorithms require that one value be calculated before the test for termination.

You can always force one repetitive statement to mimic another by appropriate programming; however, the "straightforward" implementation is usually "cleaner," easier to debug and more understandable.

It is often desirable to execute a particular statement based on some variable criteria. To select one statement among N is the CASE statement:

```
•
•
CASE i OF:
L1:     S1;
L2:     S2;
     •
     •
LN: Sn  END
```

If i equals L1 then S1 is executed; if i equals L2 then S2 is executed and so on.

"Standard" Pascal does not define the action of the CASE statement when i cannot be matched with an L. Implementations of Pascal based on the University of California at San Diego extend Pascal to define the alternate execution to begin with the statement following the END. This system, like standard Pascal, supports a shorthand if several statements are identical; all Ls belonging to a particular statement are simply listed as

Li, L_L . . . L_Z : Si;

With the exception of simple input and output, no work gets performed without the assignment statement. The effect of this statement is to assign or transfer a value to a variable:

A: = E

means "A receives the value of E" or "the value of A is replaced by the value of E." Further, E may be an expression (a formula or rule for computation that yields a value or result) with an arbitrary number of operators and operands. Operands may be either constants (e.g. numbers), variables or values resulting from a function call.

Pascal operators are classified as monadic (one operand) or dyadic (two operands) and have a hierarchy of precedence or priority. In the absence of explicit parenthesis, implied grouping occurs as illustrated in Table 8.

Table 8. Priority of Operator Precedures

a + b + c	=	(a+b)+c
a * b + c	=	(a * b)+c
a + b * c	=	a+(b * c)
a − b * c − d	=	(a−(b * c))−d
a * b + c * d	=	(a * b)+(c * d)
− a + b / c	=	(−a)+(b/c)
a * b / c	=	(a * b)/c
a / b * c	+	(a/b) * c

Unlike other languages like FORTRAN and BASIC, Pascal has no intrinsic limitation on the number of characters used in an identifier. Likewise, integer and floating point precision is arbitrary. In both cases, limitations on size are purely implementation dependent. Why allow such long identifiers? The use of long identifiers often increases the readability of programs and enhances their maintainability. For example, INITP and INITD convey much less information than INITALIZEPROGRAM and INITALIZEDATA.

Lastly, the statements of Pascal have been designed so that it is relatively easy to apply "proof of correctness" techniques to Pascal programs.

DATA TYPES

Pascal is a fully typed language; all variables are explicitly defined in the heading of a program or block. This provides an essential piece of documentation, namely a list of what variables are used and a range of values. The definiton of each and every variable and the range associated with it has several important reasons for being required:

1. Without explicit definition of the range, the algorithm may be difficult or impossible to understand. Furthermore, program bugs are tedious to uncover.
2. The validity and suitability of a program are dependent on the range of its values, e.g. division by zero is undefined.
3. The number of bits to represent a value is dependent on its range. In order to have a reasonable storage allocation by the compiler, it is necessary to provide it with the range.
4. An operation may be undefined or yield improper results. These errors can be flagged by the compiler fairly easily.

A variable declaration is indicated by:

VAR V : T

where V is the identifier of the variable and T is its type. Like the CASE statement, you can abbreviate by writing:

VAR $V_1, V_2, V_3, \ldots, V_n$: T

when all variables V, through V_n have the same type. One desirable side effect of such declarations is that it provides a "redundancy check" against the possibility of spelling or key-entry errors.

Two classes of data are generally used: Structured and unstructured. An unstructured (scalar) value is not decomposable into components and forms the basis for structured data types. Certain scalar types are frequently used and are predefined. To define a type, the statement:

TYPE t = T

is used. t is the identifier and T describes the type by enumeration. Examples are:

TYPE color = (red, yellow, green, blue)
TYPE sex = (male, female)
TYPE state = (Alaska, Vermont)

In addition to enumeration, the ordering of the elements is implied by the left to right ordering of the enumeration. Thus it is possible to use the successor and predecessor functions on all data types. For example:

succ (red) = yellow
pred (green) = yellow

Structured data types allow collections of data to be referenced by one name. These variables consisting of several components are called structured variables. To define the type (range of values) of a structured variable, you simply specify:

1) the method of structuring
2) the type(s) of its components

The Pascal structuring method FILE:

TYPE f = FILE OF t

defines a type f with properties like a magnetic tape. That is, it is a sequence which must be accessed in order. For example:

TYPE book = FILE OF char

Data stored on the following devices is considered to be a file: magnetic tapes, disks, drums, card readers, punches, papertape readers, and line printers. All these devices are considered as files in order to formulate their characteristics in a general manner. This serves as a level of abstraction in order to avoid device specifics.

A variable with an array structure is a date structure with component variables of the same type. To distinguish arrays from files, arrays additionally include:

1) each component is explicitly denotable and directly accessible.
2) the size of the array is fixed once defined.

In order to handle these additional characteristics, it is necessary to denote individual array components and define array-structured types.

Like in many other programming languages, components are defined by the variable name and an index which uniquely defines the desired element. The only restriction on the index is that it must be a scalar type. Note that it is permissible to refer to the house variable (array) indexed by color.

With this addition, Pascal arrays have similar properties to FORTRAN or ALGOL in that appropriate operations may be performed (e.g. sorting and searching). Figure 13 illustrates the use of an array.

```
VAR i: 0 . . . .N1;
    A: array [1 . . . . N1] of T;
BEGIN (* assign values to A[1] . . . A[N1] *)
    i:= 0; A(N1):= x;
    REPEAT i:= i + 1 UNTIL A[i] = x;
END;
```

The value to be searched for is x. Since A[N1] is one position past the end of the array to be searched, i will be incremented until A[i] = x and will stop with the first occurrence of x. If i = N1 the x was not in the array.

A may be represented as:

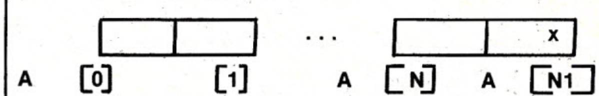


Figure 13.

Most programming languages provide the programmer with a subroutine or subprogram facility. Pascal includes two such possibilities: the procedure and FUNCTION call. Procedures are declared in two parts: the procedure heading and the procedure body: The heading identifies the procedure (assigns it a name) while the body consists of the statements that make up the procedure.

The use of procedures can have a profound affect on the quality and clarity of a program. Procedures serve to abbreviate the source code, and more importantly, they partition and structure the program. While partitioning may not seem to be important when considering a small program, when the program text gets large, partitioning is imperative in understanding the operation of the algorithm.

Proof of this technique is most dramatic in the writing of operating systems and compilers. Programs which used to require more than 5 man-years can now be completed in less than 1 man-year using Pascal and top-down structured programming techniques. In fact, Brinch-Hansen at UCLA, with

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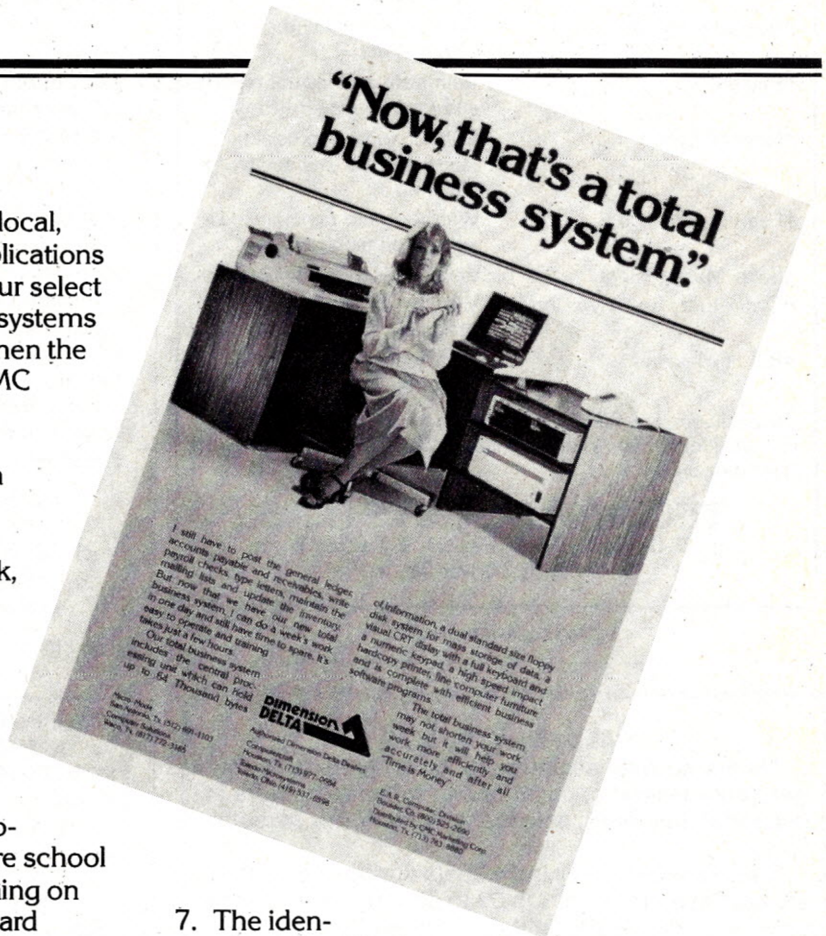

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4. TRAINING AIDS, a software-hardware-marketing school conducted at our location to indoctrinate you in the DIMENSION DELTA program and limited in size. And a hardware school for your technical people. In depth training on the equipment to back up CMC's standard warranty program.
5. A DIMENSION DELTA users group, with information coordinated and distributed for the benefit of all.
6. LIMITED selection of DIMENSION DELTA dealers, so the "man next door" won't be your competitor.
7. The identification of being the authorized DIMENSION DELTA dealer. Customer referrals will return to you.
8. Recommendations and assistance in providing leasing arrangements between you and your customer.

This is just the start of our program. We are dedicated to our dealers and suggestions from you are taken very seriously. Give us a call and ask for the DIMENSION DELTA representative. You know CMC MARKETING CORP, but if you want further references, we will be glad to give you a list of our current DIMENSION DELTA dealers. THEY WILL GIVE YOU THE GOOD WORD.

Dimension DELTA

Distributed Exclusively By:
CMC Marketing Corp. 10611 Harwin Drive Suite 406 Houston, TX 77036 (713) 995-4960

one graduate student, wrote a Concurrent Pascal compiler and several operating systems in less than one year, in addition to performing his regular teaching duties.

The purpose of using a procedure is to allow you to assign a name to a compound statement (subroutine) and then invoke the procedure simply by writing the procedure name. In order to foster generality of procedures, Pascal allows "local" variables to be used and declared in the procedure. These variables may only be accessed within the procedure and the memory assigned them is released for other uses upon termination of the procedure. This means that the local variables are undefined at the start of every call to a procedure.

This condition may be avoided by making the variable global (defined in the main program and available to any procedure) but should be used only when absolutely necessary. It is entirely possible within this framework to have an object X which is defined on one level and another object with the same name defined on a lower level. In this case, the second object is the local variable and the global variable X is not available for use.

Procedure parameters allow information to be passed from an outer level to an inner level. Formal parameters are listed in the procedure heading to denote operands and are local variables. Objects which are substituted for the formal parameters are known as actual parameters and are specified in the procedure call. The type is defined by the formal parameters. Why all the fuss over parameters? Pascal allows you to specify the kind of substitution desired. The substitution is classified into three basic categories:

1) call by value — the parameter is evaluated and the resulting value is substituted for the formal parameter.
2) call by reference — the parameter is a variable.
3) call by name — the parameter is passed literally with no evaluation. This occurs only rarely.

See Figure 14 for a detailed example of parameter substitution.

```
VAR i: INTEGER;
    A: ARRAY [1. . 2] of INTEGER;
PROCEDURE P ( b: INTEGER);
BEGIN     i ! = i + 1; b: = b+2
    END;
BEGIN (* MAIN PROGRAM *)
    A [1] : = 10; A [2] := 20; i:= 1;
    P (A[i] );
END:
Case 1: call by value
        b is a variable whose initial value is 10 and final value of
        A = (10, 20)
Case 2: call by reference
        b is defined to be A[1] so the
        statement b:= b+2 now means A[1] : = A [1] +2
        and the final value is A= (12, 20)
Case 3: call by name
        b is defined to be A[i] so the
        statement b:= b+2 now means A[i]:= A [i] +2
        with final value A=(10,22)
```

Call by value is default, call by reference is specified by using VAR as a prefix to the formal parameter(s) and call by name is indicated by using a function as the prefix of a formal parameter.

Figure 14.

Functions are like procedures with the added feature that the result of a function is called a value. Thus, it is allowable to use a function call in an expression.

This covers the basics of Pascal. A future chapter will review the overall workings of the computer.□

The author can be contacted at American Microsystems, Inc., 3800 Homestead Road, Santa Clara, CA 95051.

Microcomputer BASIC Compiler

An efficient microcomputer BASIC compiler for 8080 and Z-80 CP/M systems supports all the extensive, commercial features of Microsoft BASIC-80. The optimized, relocatable machine code produced by the BASIC compiler is in Microsoft's standard binary format.

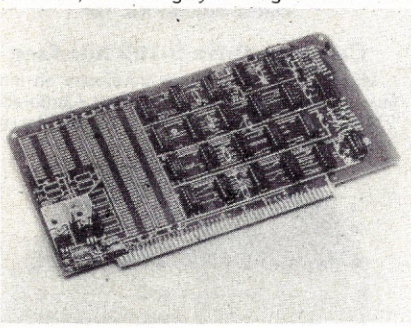
Compiled BASIC programs can be loaded and linked with subroutines generated by Microsoft's FORTRAN-80 and COBOL-80 compilers, and MACRO-80 macro assembler.

For details contact Microsoft, 10800 NE 8th, Suite 819, Bellevue, WA 98004.

CIRCLE INQUIRY NO. 121

"Fast Scan" Video Digitizer

Vector Graphic's Fast-Scan Video Digitizer allows quick storing of video images in computer memory. Simply, it converts output from a standard TV camera, or any other source of composite video, into 8-bit grayscale digital information.



Data can then be transferred via software to one of two media: a memory-mapped high resolution video board for display on a video board; or main RAM for storage and subsequent retrieval.

Price is $175. For details contact Vector Graphic Inc., 31364 Via Colinas, Westlake Village, CA 91361.

CIRCLE INQUIRY NO. 126

MAGSAM™

Micro Applications Group has introduced a keyed file management system called MAGSAM designed for the CP/M operating system.

MAGSAM allows CP/M and CBASIC users to create and access data records quickly and directly by user defined keys. Records may be retrieved randomly by key, sequentially by key, generically by key, sequentially in chronological order, and randomly by relative record number.

Records may be created by randomly by key and sequentially by key, and updated by any of the retrieval methods.

For details contact Micro Applications Group, 7300 Caldus Ave., Van Nuys, CA 91406.

CIRCLE INQUIRY NO. 122

FIRES

Fast Identification and Routing of Engineers to Service (FIRES) is a field-tested software solution for companies which dispatch service personnel to on-site customer locations.

Primary functions include: Service Dispatching, Billing, Product Analysis, Cost Accumulation, Parts Requisition, Office Analysis/Reports.

For details contact Integral Business Computing Inc., 1440 W. Pacific Coast Highway, Harbor City, CA 90710, (213) 539-0530.

CIRCLE INQUIRY NO. 123

Mailing List System

MAIL-V is the first package of Series V business software for the TRS-80 DOS system. It will be used with other Series V systems, such as WORD-V, which will get the mailing list information and produce personalized letters.

MAIL-V includes a report writer, which allows you to specify the report or label formats on-line. One or more labels across a line can be selected. Fields include new zip code extensions, last reference data and remark field. A selection code ranging from 0 to 32,000 is used to classify labels.

TRS-80 DOS and 32K memory are required. Price is $59 with full documentation. For more information contact Micro Architect, 96 Dothan St., Arlington, MA 02174.

CIRCLE INQUIRY NO. 124

Accounting Software for Micropolis

LEDGERPLUS — THE COMPANY BOOKKEEPER™ is an interactive software package designed for Data General, Vector Graphic, Apple and TRS-80 microcomputers with Micropolis disk drives.

The new package consists of general ledger, accounts receivable, accounts payable, payroll, check reconciliation, inventory control, and mailing list applications. All of the modules may be used separately or in conjunction with the others.

Operating instructions and documentation for LedgerPlus are written for those without computer experience.

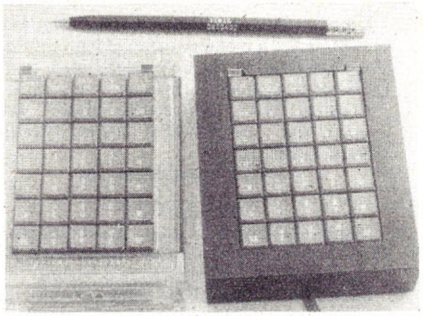
Modules for Data General and Vector Graphic equipment retail for $495, and $295 each for Apple and TRS-80. For details contact MicroSource, 1425 W. 12th Pl., Tempe, AZ 85281.

CIRCLE INQUIRY NO. 125

CIRCLE INQUIRY NO. 98

Remote Keypad System

Gimix announces its new 35-button remote keypad system for data entry applications where a numeric pad isn't enough and a full size keyboard would be too large or inconvenient.



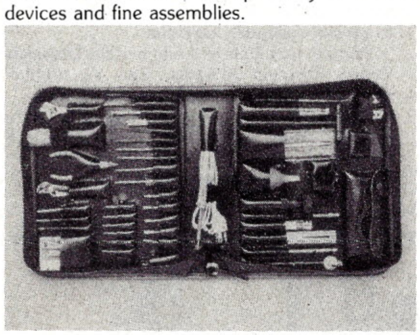
Each keypad has 34 data keys and a shift key arranged in a 5x7 matrix. Each data key generates 2 distinct codes depending on the status of the shift key.

Price is $118.82 in wood case; $128.82 in acrylic. For details contact Gimix Inc., 1337 W. 37th Pl., Chicago, IL 60609.

CIRCLE INQUIRY NO. 127

Miniature Precision Tool Kit

Jensen Tools Inc. has developed a new miniature and subminiature precision tool kit designed for scientists, electronic technicians and instrument mechanics who work primarily on intricate devices and fine assemblies.



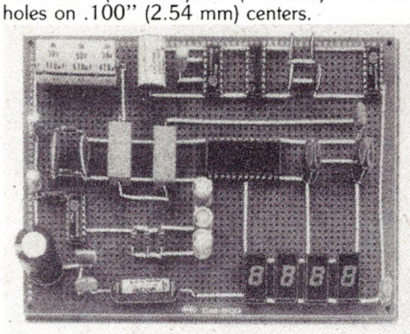
Designated the JTK-24, the kit contains more than 120 tools in a 10½ x 12½" multi-pocketed padded zipper case. Included are miniature screwdrivers, nutdrivers, pliers, wrenches, spline and hex keys, needle files, precision drills, optical aids, soldering equipment and more.

For details contact Jensen Tools Inc., 1230 S. Priest Dr., Tempe, AZ 85281, (602) 968-6231.

CIRCLE INQUIRY NO. 128

Solderless Prototype Board

CM-600 is a unique system for solderless construction of circuit prototypes, useful to both engineers and hobbyists. The CM-600 is a neoprene board 4½" (114 mm) x 6" (152 mm) with 2280 holes on .100" (2.54 mm) centers.



Standard components including DIPs are mounted by simply inserting leads into the holes. Interconnections are easily made using 20 or 22 AWG (0,8 or 0,65 mm) wire jumpers.

Price is $6.95 each. In stock at local electronics distributors or contact O.K. Machine and Tool Corp., 3455 Conner St., Bronx, NY 10475.

CIRCLE INQUIRY NO. 129

Bidirectional Printer

The MT-80 is a 125 characters per second, 80- and 120-column bidirectional printer. The unit supports the full upper and lower case 96-character ASCII set in three software selectable fonts (5, 10 and 15 characters per inch) on original plus three copies.

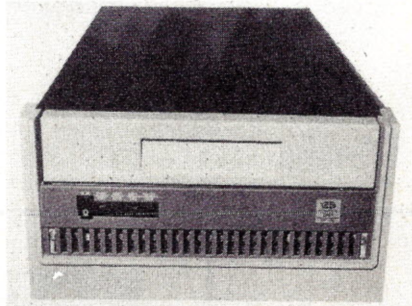
The microprocessor-controlled printer contains a 240 character buffer with additional data buffers to 4K optionally available in 1K increments.

Price is $750. For details contact Microtek, Inc., 7844 Convoy Ct., San Diego, CA 92111, (714) 278-0633, Daniel Obed, Dir. of Mktg.

CIRCLE INQUIRY NO. 130

Cartridge Drive S-100 Interface

MicroAge Wholesale has developed an interface capability for the Control Data Corporation CMD 16/16 cartridge drive to North Star and Alpha Micro-based microcomputer systems.



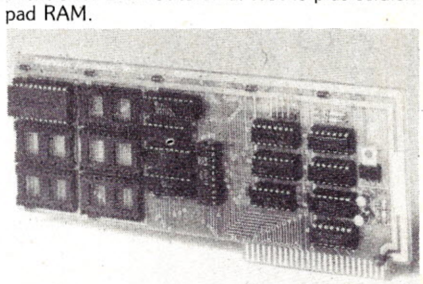
MicroAge includes the drive, S-100 controller, software interface and disk pack in one package. The cartridge drive features 26 megabytes of formatted and 32 megabytes unformatted storage.

For more details contact MicroAge, 1425 W. 12th Pl., Tempe, AZ 85281, (602) 967-1421.

CIRCLE INQUIRY NO. 131

More Power for Apple

Mountain Hardware, Inc., has introduced its ROMPLUS+ board for Apple Computers. The new board offers six individually addressable sockets for 2K ROMs or EPROMs plus scratchpad RAM.



Included is a 2K ROM program "Keyboard Filter™" which offers upper/lower case for the Apple, multiple user-defined character sets, colored or inverse-colored letters, keyboard macros, improved cursor control, and other improved graphics and editing functions.

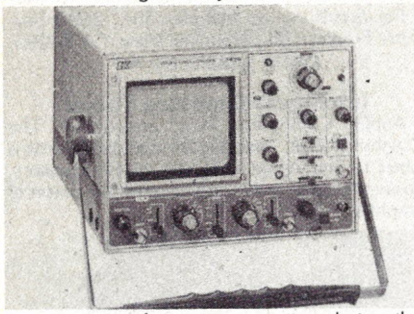
Price is $169. For details contact Mountain Hardware, Inc., 300 Harvey West Blvd., Santa Cruz, CA 95060, (408) 429-8600.

CIRCLE INQUIRY NO. 132

Dual Trace Scope

The Model 1479 dual-trace, delay-line scope is designed for applications where high-speed waveforms must be viewed with clarity and accuracy.

A significant feature of the new scope is an internal 160nS signal delay line which allows the



user to view information appearing during the short rise and fall times of high-frequency waveforms. Minimum visible delay is 12nS.

Price is $1,099. For details contact B&K-Precision/Dynascan Corp., 6460 W. Cortland St., Chicago, IL 60635, (312) 889-9087.

CIRCLE INQUIRY NO. 133

Bubble Memory Design Handbook

A 64-page catalog presenting the features, descriptions, and functional characteristics of the 7110 one-megabyte bubble memory and its support chip family is now available from Intel Magnetics, Inc.

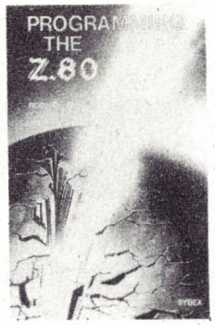
Included in the handbook are specifications, diagrams and tables for the Intel Magnetics 7110/7112, a 1.048,576-bit magnetic bubble memory (MBM), the 7220 controller (BMC), 7230 current pulse generator (VPG), 7242 dual formatter/sense amplifier (FSA), 7250 coil predriver (CPD), 7254 quad VMOS drive transistors, and IMB-100 development board.

For details contact Intel Magnetics, 3000 Oakmead Village Dr., Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 135

New Book from Sybex

Programming the Z-80, by Rodnay Zaks, offers a comprehensive description of the Z-80 instruction set and a thorough account of its internal operations.



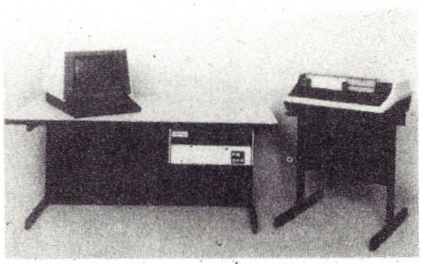
It can be used as an introductory text on programming or as a self-contained reference book. One chapter on data structures includes lists, tables, binary trees, hashing and other algorithms.

Contact Sybex Inc., 2020 Milvia St., Berkeley, CA 94704, Chris Chambers, (415) 848-8233.

CIRCLE INQUIRY NO. 134

Hard Disk Computer System

The System B-200 is a 10-million character hard disk multi-user computer system for the small



business user. The B-200 will handle up to four CRTs or printers in any combination. The system comes complete with two CRTs. Additional CRTs or printers can be added by plugging them in.

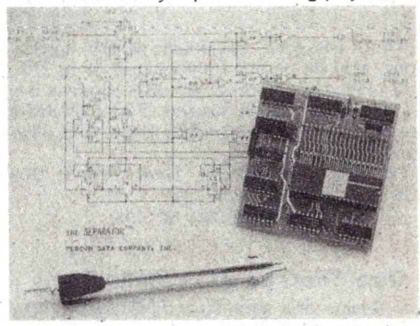
The operating system includes full system utilities, and extended BASIC with random access data files. Disk files contain diagnostics for all system devices.

The system is packaged in a desk with printer stand. Price is $19,995. Contact Basic Time, 1215 E. El Segundo Blvd., El Segundo, CA 90245, (213) 322-4435.

CIRCLE INQUIRY NO. 136

Plug-In Adapter for Disk Controllers

The Separator is a plug-in adaptor for the TRS-80 and Southwest Technical Products' MP-F mini-disk controllers which virtually eliminates the data read errors caused when clock and data bits are not reliably separated during playback.



The Separator maybe installed without making any changes to the host system. Merely remove the 1771 disk controller IC from the host controller, install the IC in the DIP socket on the Separator card and plug the card into the vacated 1771 socket of the host system.

For details contact Percom Data Co., 211 N. Kirby, Garland, TX 75042.

CIRCLE INQUIRY NO. 137

Double-Sided Diskettes

Two new double-sided diskettes, for dual-head drives, are now available from the Data Recording Products Division of 3M.

The 742 Diskette, compatible with single-density diskette drives, will be used on IBM 5110 and compatible systems.

7430 Diskettes, for double-density applications, may be obtained unformatted or in 256, 512 and 1024 formats for IBM System 34, 5110 and compatible systems. 743-2 Diskettes are available for Shugart 850 drives and other compatible systems.

For details contact 3M, Dept. DR9-9, Box 33600, St. Paul, MN 55133.

CIRCLE INQUIRY NO. 138

Data Sheet on 2114 Static RAMs

A 4-page data sheet from EMM/Semi, Inc., covers the 2114-2 and -3 and the 2114-U in both standard and low power versions.

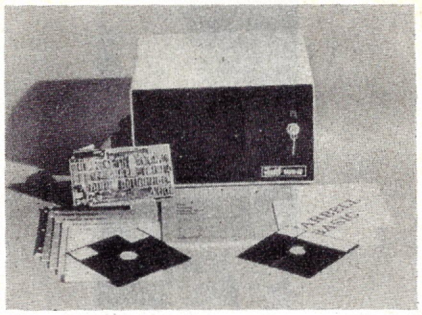
Included are complete component parameters and characteristics plus sufficient descriptive and functional information to permit the engineer to order directly from the data sheet.

For details contact EMM/Semi, Inc., 2000 W. 14th St., Tempe, AZ 85281, F.L. Krch, Mktg.

CIRCLE INQUIRY NO. 145

Dual Disk Drive System

The VDS-II Vertical Disk Subsystem is a Shugart-compatible single-density, single-sided dual drive system which uses standard IBM-compatible soft sectored 8" diskettes. Capacity per drive is 256K bytes.



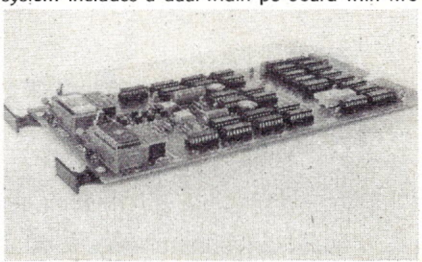
The VDS-II includes two Siemens 8" disk drives, Tarbell floppy disk interface, CP/M disk operating system, and Tarbell BASIC.

Price is $1,888. For details contact Tarbell Electronics, 950 Dovlen Pl., Suite B, Carson, CA 90746, (213) 538-4251 or 538-2254.

CIRCLE INQUIRY NO. 139

EPROM Programmer

The Model PR77E is an EPROM Programming System for the DEC LSI-11 microcomputer. The system includes a dual-width pc board with two



independent channels, a utility software package on diskette intended for use under RT-11, two sets of EPROM-unique adaptor plugs and a user's manual.

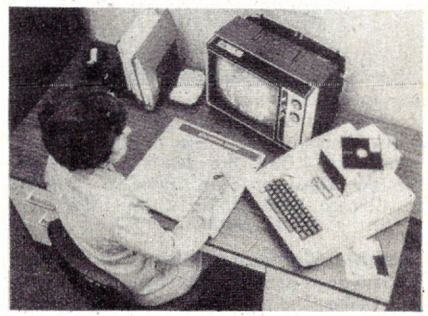
The system will program the Intel 2704, 2708, 2716 and 2732, the Texas Instruments 2716, 2516 and 2532 and their equivalent EPROMs.

For details contact Interplex, Inc., 2680 Bayshore Frontage Rd., Mountain View, CA 94043.

CIRCLE INQUIRY NO. 140

Intelligent Graphics Tablet

Apple Computer, Inc., announces The Graphics Tablet. Attaching the compact, portable tablet to any Apple computer gives educators, business people, artists and scientists the power of graphics.



The tablet, once installed, is ready to use with a standard software package (written in BASIC) whenever the computer is turned on; and it can be customized by the user with special symbols and functions.

It features an 11x11-inch drawing surface, a coated mylar overlay (containing the menu of tablet functions), a stylus, disk-based software, and a printed circuit interface card which plugs into the Apple computer.

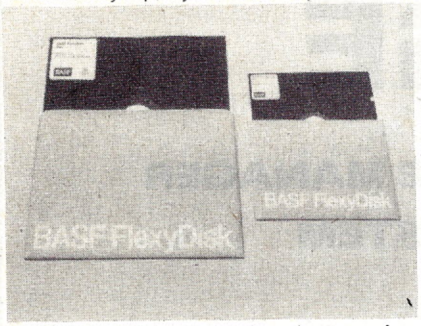
Price is $795. Contact Apple Computer, Inc., 10260 Bandley Dr., Cupertino, CA 95051.

CIRCLE INQUIRY NO. 141

CIRCLE INQUIRY NO. 16

BASF Diskettes

A line of double-sided, single and double density 5.25" FlexyDisks® are offered in either soft or hard (10 and 16) sectored formats. Single-density capacity is 250,0o00 bytes (unformatted), while double-density capacity is 500,000 bytes at 48 tpi.



BASF FlexyDisks are packaged in static-free, dust-free Tyvec® sleeves and are available in small or large quantities. Each box contains write-protect tabs and coding and filing labels.

For details contact BASF Systems, Computer & Business Prod. Dept., Crosby Dr., Bedford, MA 01730.

CIRCLE INQUIRY NO. 142

Computer Accessories

Timberline Systems, designers of computer software programs for minicomputers, as well as providing software, hardware, training and post-installation support, has formed a Computer Accessories Division. With this addition, Timberline

can now supply all the computer room needs for a first-time customer.

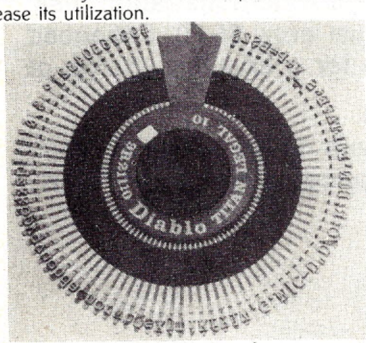
Accessories available include continuous forms paper, binding systems, data storage cabinetry, microfiche, computer magnetics, and more.

For details contact Timberline, c/o Thuemmel, Mark & Assoc., 1020 Corbett Bldg., Portland, OR 97204.

CIRCLE INQUIRY NO. 143

Print Wheel Customizing

Through a new program of print wheel modification, Daisytek, Inc., can now meet the specialized needs of its word processing customers. The customization involves installing a selected character on any standard metal print wheel to increase its utilization.



The Daisytek modification process, which employs a metal composite character versus a plastic character, helps ensure durability and performance of the modified wheel.

For details contact Daisytek, Inc., 717 Lingco, Suite 216, Richardson, TX 75081.

CIRCLE INQUIRY NO. 144

Fast 8K EPROM from TI

The TMS2508-25 8K EPROM features a maximum access time of 250 nanoseconds and requires only a single 5-volt power supply.

The TMS2508 also features automatic chip-select/power down, low power-dissipation and

fully static operation. Data stored in the device may be erased using ultraviolet light. The TMS 2508 can be programmed single or in blocks, sequentially or at random.

For details contact Texas Instruments Inc., MOS Memory Div., P.O. Box 1443, M/S 6955, (Attn: TMS2508) Houston, TX 77001.

CIRCLE INQUIRY NO. 146

Business Software

P.S., Inc. General Ledger Software System is of flexible, modular design. Up to 10,000 general ledger accounts can be established and maintained with this system.

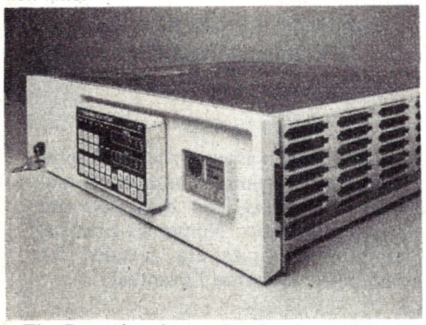
All forms generated, including Profit and Loss Statement and Balance Sheet are modular, which allows each user to specify the content and printing order of all accounts in the general ledger.

For details contact P.S., Inc., 619 N. Pacific Ave., Fargo, ND 58107, (800) 437-4774.

CIRCLE INQUIRY NO. 149

General Purpose Minicomputer

Educational Data Systems announces the addition of the Point 4 16-bit minicomputer to its growing product line. The Point 4 is so named because of its .4 microsecond instruction execution time.



The Point 4 is designed to be compatible with IRIS and the Mighty Mux as well as with other software and peripherals designed for Nova-type minis. The system features a high-speed interprocessor bus that permits computer-to-computer communications at speeds up to two megawords per second.

For more information contact Educational Data Systems, 1682 Langley Ave., Irvine, CA 92714, (714) 556-4242.

CIRCLE INQUIRY NO. 147

Word Processor/Business System

The System-Z Word Processor + Business System is a fast-typing secretary, careful accountant, efficient order taker, friendly gamesperson, and serious on-line computer system.

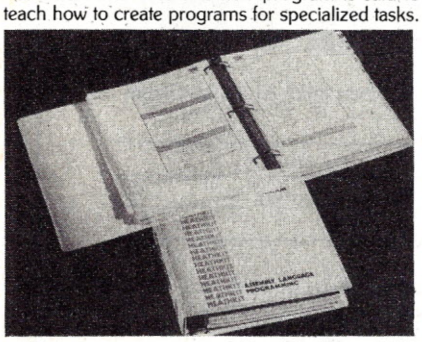
The System-Z features the Z-80 processor, S-100 bus, CP/M DOS, a full-sized disk drive, 32K RAM, basic printer I/O, fully encoded ASCII keyboard, CRT video monitor, and software from our extensive library.

Price is $2899 assembled and tested. Contact MicroDaSys, P.O. Box 36051, Los Angeles, CA 90036, (213) 935-4555.

CIRCLE INQUIRY NO. 148

Assembly Language Self-Instruction

A new Microcomputing Assembly Language self-instruction program from Heath is designed to free the computer user from dependence upon "canned" software. The new program is said to teach how to create programs for specialized tasks.



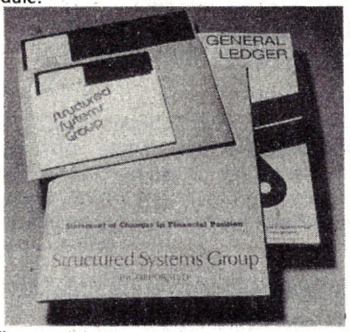
While written to support Heath's H8 or H89 computers, the program is fully applicable to any 8080, 8085 or Z-80 based systems.

For details contact Heath Co., Benton Harbor, MI 49022.

CIRCLE INQUIRY NO.150

General Ledger Update

Structured Systems Group announces the enhancement of its General Ledger microcomputer accounting software package with the SCFP Statement of Changes in Financial Position Module.



The module is available as an update to all registered owners of the SSG General Ledger, and is now shipped at no extra charge as part of the General Ledger System.

The SCFP module automatically produces two statements: the Sources and Uses of Working Capital, and the Changes in Components of Working Capital.

For details contact Structured Systems Group, 5204 Claremont Ave., Oakland, CA 94618, Lance Batten.

CIRCLE INQUIRY NO. 151

TRS-80 Business Software

Taranto & Associates announces a new business package for the TRS-80: an Invoicing System designed to interface directly with the Osborne & Associates Accounts Receivable System.

The Invoicing System provides the ability to enter sales items in the computer, picking up the customer name and address from the A/R system file, computing sales taxes, and printing the invoice on one of two available pre-printed forms. Completed invoice transactions are automatically transferred to the Accounts Receivable system for accounting and full reporting functions.

Price is $99.95. For details contact Taranto & Associates, P.O. Box 6073, 4136 Redwood Hwy., San Rafael, CA 94903, (415) 472-1415.

CIRCLE INQUIRY NO. 152

General Ledger System

Data Master is a general ledger system designed for use with the Micropolis computer. The system is written in BASIC and responds to menu/prompts.

The Data Master system provides the user with instant trial balance as records are entered or updated, account number validation as journal records are entered, and automatic file open/close after every ten journal input transactions to prevent power failure loss of more than 10 records. The chart of accounts is index sequential access method file type.

The Data Master system includes floppy disk, trial chart of accounts and an easy-to-read installation/training manual. Price is $150. For details contact Data Master, P.O. Box 88, Hamburg, IA 51640, (712) 382-2738.

CIRCLE INQUIRY NO. 154

Checkbook Balancer

TBS Inc. has released CHECKBOOK II for the TRS-80. Requiring 16K or more, this program does everything that is necessary to keep your checkbook balanced and then some. The program has keyboard input that directly prints on screen in five columns. The program can handle amounts up to $1,000,000 and uses codes of up to four alpha or numeric characters.

A Search and Total routine is provided and can search out any field but amount, and displays those checks on screen and totals them. The program also has a numeric sort routine.

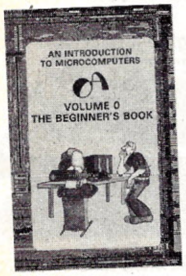
Price is $18.50. For more information contact The Bottom Shelf, Inc., Box 49104, Atlanta, GA 30359, (404) 939-6031.

CIRCLE INQUIRY NO. 155

MICROCOMPUTER BOOKSHELF

AN INTRODUCTION TO MICROCOMPUTERS

Volume 0 — The Beginner's Book
by Adam Osborne



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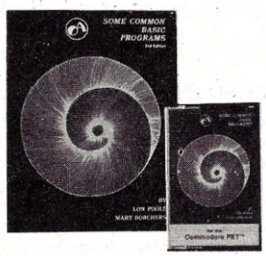

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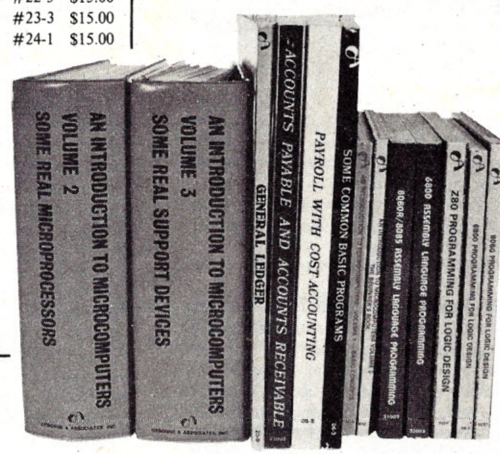

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S1025

ED-80: SDT's Editor for CP/M

Review by Alan R. Miller, Software Editor

INTRODUCTION

The text editor is probably the most important program in the CP/M system library. It is needed for creation and alteration of source programs used by almost all of the other executable programs. These include the FORTRAN and CBASIC processors, the text output formatter TEX, and the assembler. In addition, the disk BASICs offered by Xitan, Microsoft, and Tarbell can operate on ASCII source files created by the system editor, even though these BASICs also incorporate their own editor.

The format of an assembler or FORTRAN source program is different from that of a work file for a technical report. The assembler or FORTRAN file is line oriented, each line containing a separate command or comment. By contrast, a report file is paragraph oriented. The user generates a work file which is converted to the desired format with a computer program.

The Electric Pencil, reviewed in the August, 1978, INTERFACE AGE, is a combination editor and output formatter. It frees the user of all concern for format during the creation phase. However, it is only usable with a memory-mapped video screen, and it is not suitable for line-oriented text.

A two-step formatter, such as TEX, approaches the problem differently. A work file is first created with the system editor, then TEX is used to convert the work file to a finished file that is in the desired format.

Since the nature of text files is so different from FORTRAN or assembler source files, it is not surprising that some editors are better at one task than others. Therefore, it is convenient to have several different editors available.

THREE TEXT EDITORS

The editor supplied with CP/M was reviewed in July, 1978. A second, CP/M-compatible editor, written by Microsoft, was reviewed in July, 1979. A third CP/M-compatible editor, offered by Software Development & Training, Inc., P.O. Box 4511, Huntsville, AL 35802, is the subject of this article.

Any of these three editors can be used to create or alter CP/M disk files. They are all compatible, since a file created by any one of them can be subsequently edited by either of the other two. (This is not true of some other CP/M editors on the market.) Each editor approaches the task a little differently, and therefore, has some unique features.

Digital Research's editor, called ED, is character oriented with a single character-pointer. There is both a command mode and a character-insert mode. A unique feature is that even the carriage returns and line feeds at the end of each line can be referenced or manipulated. Two adjacent lines can be concatenated by deleting the carriage-return, line-feed pair between them. Alternately, one line can be split into two by inserting a carriage-return, line-feed pair in the middle of the original line.

This editor is useful for the creation of both line-oriented and paragraph-oriented text. But, except for the joining or unjoining of lines, the alteration of text with this editor is not easy.

Microsoft's ED-80 is very different. In addition to the command mode, there is both a line-edit mode and a character-edit mode. Both a character pointer and a line pointer are separately maintained. It is very similar to the editors found on disk and extended BASICs.

This editor is very useful for source-program alteration. In the character mode, it is possible to search for a character then delete everything down to another character. With this approach, it is not necessary to know how many characters are to be deleted.

SDT's editor, called ED-80, combines some of the best features of both the other two editors and adds some interesting new features as well. There are 36 distinct commands with more than 50 variations. The major ones are given in Table 1. Numerous messages such as:

END OF FILE:00405 and
EDIT MODE

keep the user informed. There is both a command and an insert mode, with a single line-oriented pointer. Small files are completely loaded into memory for editing, while larger files are brought into memory a block at a time.

A CP/M disk file is created or edited with the command:

A>ED80 filename

If a new file is being created, the editor will automatically enter the insert mode at this time and give the statement NEW FILE. On the other hand, if an existing file is to be edited, it is automatically loaded into memory and edit mode is invoked. The statement:

TOP OF FILE:0
0:f>

is given to indicate that the line pointer is positioned at the top of the buffer. (There is no character pointer.)

The usual CP/M system commands can be used for editing during keyboard input. Control-P can be used to send

Table 1. The major ED-80 commands.

A	append
BU	make backup
BLANK	blank mode
B	pointer to bottom
BUFFER	buffer mode
CASE	upper-case switch
C	change line
D	delete line
DUMP	print line with control characters
EDIT	enter edit mode
EXIT	normal edit end
F	find string
FILE	enter file mode
GET	get disk file
I	insert line
IN	inline editing
INPUT	enter input mode
L	locate string
LST	print lines on list device
MD	define macro
ME	execute macro
MP	display macro definition
N	move pointer n lines
NB	get next disk buffer
OMIT	discard edit session
P	print lines
PLN	print lines with numbers
PUT	make disk file
R	replace lines
RESTART	combination EXIT and EDIT
S	put scale line under current line
T	move to buffer top
TABSET	define tab locations
TCHAR	define transparent character
U	move pointer up
W	window
X	execute macro 1

console output to the list device. (There is also a separate command, LST, that can be used to send lines directly to the line printer only.)

Control-U cancels the current line. The DEL/RUB OUT key removes the most recently typed characters, embedding it in a pair of backslash characters. Control-R reprints the corrected version of the input line. ED-80 has an additional feature not available on the other two editors. Control-H (backspace) can be used to delete the last character typed. In this case, the cursor actually backs up on the video screen. If a tab is deleted in this way, the cursor backs up the correct number of spaces until it is positioned next to the previous character on the screen.

THE WINDOW COMMAND

The window command, a unique feature of the SDT editor, can be given any time during EDIT mode. This command is invoked either by typing the letter W and a carriage return, or even more quickly by pressing just the at-sign, @. The window command immediately fills the console video screen with lines of text from the edit buffer (Listing 1). The current line is clearly indicated with a > symbol, and will usually be in the middle of the screen.

```
 00009: .sp
 00010: INTRODUCTION
 00011: .ti3
 00012: The text editor is probably the most important program
 00013: in the CP/M system library. It is needed for creation
 00014: and alteration of source programs used by almost all
 00015: of the other executable programs. These include the
 00016: FORTRAN and CBASIC processors,
 00017: the text output formatter TEX, and the assembler.
 00018: In addition, the disk BASICs offered
 00019: by Xitan, Microsoft, and Tarbell can operate on ASCII
>00020: source files created by the system editor, even though
 00021: these BASICs also incorporate their own editor.
 00022: .ti3
 00023: The format of an assembler or FORTRAN source program
 00024: is different from that of a work file for a technical
 00025: report. The assembler or FORTRAN file is line oriented,
 00026: each line containing a separate command or comment.
 00027: By contrast, a report file is paragraph oriented.
 00028: The user generates a work file which is converted to
 00029: the desired format with a computer program.
 00030: .ti3
 00031: The Electric Pencil, reviewed in the August 1978 issue
20:f>
```

Figure 1. The ED-80 window command.

Each line is prefaced with a sequential line number. These line numbers, which are used in some of the editing commands, are not actually placed into the edit buffer. They are generated each time they are needed. Furthermore, they will change as lines of text are added or deleted.

Typing a WN (for window next) and a carriage return, or just slash, will move the line pointer down one screen width, and display the next window of text lines surrounding the current line. The window can be moved upward (towards the beginning of the buffer) with a WP (window previous) command and a carriage return, or just a line feed. These window commands give the user an instant picture of the text in the vicinity of the current line.

MOVING THE POINTER

Many of the edit commands operate only on the current line. There are several ways to move the pointer to the desired line prior to giving the command. As with ED, a carriage return moves the pointer to the next line and displays it. A left bracket moves the pointer backward one line. Typing an N and a positive or negative number, or just a number with a plus or minus sign in front, moves the pointer by that many lines forward or backward.

The pointer is moved to a particular line by typing just the line number. A command of T moves the pointer to the top of the buffer and a command of B moves it to the bottom. (By comparison, the B command in the CP/M editor, ED, moves the pointer to the beginning of the buffer.)

GLOBAL FIND AND LOCATE

The F (find) and L (locate) commands are a most effective way to locate strings for editing. Both commands operate globally from the current line to the end of the buffer (or backwards to the beginning of the buffer if a suffix B is included):

```
F    SORT
L    CALL   SORT
LB   SORT
L
```

The first line containing a match with the given string is displayed on the console and the pointer is moved to this line. The L command will look for the string at any position in the line, and so is more frequently used than the F command.

The F command always looks for the match to start in column one. This command is useful for locating labels, especially those that don't end in a colon. In the above example, the command F SORT would ignore the expression CALL SORT and JMP SORT since the string SORT doesn't start in column one. It would, however, find the label SORT: since it does begin in column one.

All occurrences of a string can be displayed with the LA (locate all) command. Move the pointer to the top of the buffer (with the T command) and give the command LA <string>. If the L or F command is given without a string statement, as in the last example above, the string from the previous invocation is used.

CHANGING THE TEXT

Text can be altered by either of two methods. One method is similar to the function editor in APL. A command of IN <line number> is given, and the requested line is reprinted. The cursor is moved under the line to the desired place. An I, R or D is typed to signify an insert, a replacement, or a deletion. The text is typed and an asterisk is used for a delimiter.

A more direct approach is to give the change command C:

```
C SQRT/SORT/
```

This will change the string SQRT to SORT if it occurs in the current line. A string can be deleted from the current line by omitting the second string:

```
C /LOOP://
```

While the string delimiters are shown as slashes, they can actually be anything not appearing in the string itself. Thus:

```
C ;3/4;1/4
```

can be used to change the fraction ¾ to ¼. Also, in these examples, the final delimiter is unnecessary. Thus C /LOOP:/ will also delete the string.

The change command can take one or two arguments consisting of decimal numbers. In this form, the terminal slash must be given.

```
C /JZ/JNZ/ 3 *
```

The first argument extends the range of the search by specifying the number of lines to be used in searching for the string (three in the example above). The second optional argument specifies how many times the change is to be made. Either or both arguments can be an asterisk denoting a maximum number of 32,767.

Text can be added to the end of a line with the A (for append) command, or to the beginning of the line with the AB command:

```
A    string
AB   string
C    //string/
```

The third form uses the C command to insert text at the beginning of the line and is equivalent to the AB command.

ARGUMENTS FOR OTHER COMMANDS

Several of the other edit commands also operate only on the current line unless additional arguments are given. But these arguments are interpreted a little differently from those used with the C command. The arguments can be either a decimal number or an asterisk.

A single argument increases the range of the command by the given number of lines (as with the C command). The asterisk refers to all the remaining lines. If there are two arguments, however, the interpretation is different. The two numbers refer to the inclusive line numbers. Some examples are:

```
D    30
D    128 142
LST  1 *
P    28
PLN  15 42
```

The first example deletes the next 30 lines, including the current line. Warning: if you attempt to delete line 30 with a D 30 you will instead delete 30 lines from the current pointer position! The second example deletes line numbers 128 through 142. The third example will send the entire buffer to the list device. The fourth command will print the next 28 lines on the console, while the last example will display lines 15 through 42 on the console and include the line numbers.

ELLIPSIS AND WILD CARDS

Strings may be referenced ambiguously. In one method, three sequential dots replace part of the string. For example, the line:

```
00038: STRT:  JZ    BEGIN    ;NEXT TIER
```

can be changed with the command

```
38:f>c /J...N/CMA^I/
```

and ED-80 responds with:

```
00038: STRT:  CMA            ;NEXT TIER
```

to show the edited version. The passage JZ <tab> BEGIN was referenced with just the first and last characters, and the three dots in between.

A second method for ambiguously referring to strings is to use the transparent character as a wild card. The command:

```
LA FILE?
```

will locate all occurrences of names like FILE1, FILE2, FILE3, etc. The transparent character can be changed during editing so that a string containing a question mark can be referenced.

CUSTOMIZING ED-80

There are several locations in ED-80 that can be optionally altered to suit the user's particular terminal. The appropriate portion of the assembly language listing is provided in the user's manual to make the task easier. The five, single-keystroke commands:

@	window
/	window next
<LF>	window up
<CR>	next line
[	previous line

are chosen so that they will be grouped in a cluster around the return key on the popular ADM terminal. For other terminals, a different set would be more useful.

The default transparent character is initially set to a null, but it can be changed to a question mark. In any case, the transparent character can be redefined at the command level during editing. The statement:

```
TCHAR !
```

will change it to an exclamation point.

The backspace key is initially defined as the ASCII backspace Control-H. This can also be redefined to another character if necessary.

These customizing changes are easily incorporated into the original COM file using DDT or SID. Then the new version can be saved with a more convenient name such as EDIT. If you also rename the FORTRAN compiler to COMPILE.COM, and the FORTRAN linking loader to EXECUTE.COM, then the commands will begin to resemble those of large computers:

```
A>EDIT  SIMPSON.FOR
A>COMPILE SIMPSON
A>EXECUTE SIMPSON
```

TABS

The default tab character is the ASCII tab, Control-I. But since some terminals don't have a specific tab key, the default value in ED-80 can be changed to something else. The user's manual suggests that the ASCII escape key (1B HEX) be substituted in this case.

The standard tab positions are located eight spaces apart, a format that is generally compatible with FORTRAN, BASIC and assembly language. But ED-80 also allows the user to predefine non-standard tab stops at any position. This may be necessary for some COBOL source programs.

It is also useful for producing general data files where, for example, a name field of 20 columns is followed by an address field of 15. With the non-standard tab option, the correct number of blanks is actually placed into the edit buffer in place of the usual tab character. This approach effectively blocks records with blanks.

THE MACRO COMMANDS

Several commands can be combined and repeated with the macro commands. The simplest form is the X (for define and execute). It can be used to give several commands at once.

The expression:

```
X L SORT & W
```

will locate the next occurrence of the string SORT and then display the window of the nearby lines. Furthermore, the operation can be repeated by just typing the X command. The arguments need not be entered if they are the same as the previous time.

Three separate macro commands can be defined (and nested) with the form MD1, MD2 and MD3. The macros are executed with the ME1, ME2 and ME3 commands which may optionally be followed by a number indicating how many times the macro is to be repeated. The current definition of the macros can be determined with the macro print commands MP1, MP2 and MP3. The X command actually refers to the MD1, ME1, and MP1 set.

A macro command coupled with a locate command can be used to find every occurrence of a string, and inspect it before actually making an anticipated change. Consider, for example:

```
MD1 C /STRING1/STRING2/
L STRING1
```

The MD1 command defines the change of STRING1 to STRING2, and the L command locates each occurrence. If after viewing a line, the user decides to change STRING1 to STRING2, it can be done by typing just an X (which is equivalent to the command ME1). An L is then typed to find the next occurrence of STRING1.

DISK LIBRARIES

The PUT and GET commands can be used to manage subroutine libraries as well as to move blocks of text from one portion of the edit buffer to another. Common routines, such as those used to convert binary to ASCII HEX, and those used for I/O, can be kept on any disk with any file ex-

tension. These routines can subsequently be copied into the edit buffer with the GET command:

```
GET B:INPUT.LIB
GET C:ASCBIN.ASM
```

The disk file will be loaded at the current position of the line pointer. ED has a similar feature, except that the file extension must be LIB, and the file must be located on the default drive.

Disk files can be generated with the PUT command:

```
PUT A:BINASC.ASM 20
PUT B:OUTPUT.LIB 20 40
```

The first example creates a file containing the next 20 lines and the second example makes a file containing lines 20 to 40. A block of the edit buffer can be relocated by first giving the PUT command without a filename:

```
PUT , 12
PUT , 20 40
```

The first form of the PUT command relocates the next 12 lines and the second form relocates lines 20 through 40. After giving the PUT command, move the pointer to the new location and give the command GET.

MISCELLANEOUS COMMANDS

The insert mode is entered from the command mode by typing either an I or an INSERT. Everything following is then entered into the edit buffer. The normal return from the insert mode back to the command mode is accomplished with a command of E or EDIT. (This means, of course, that a label called EDIT cannot be used without a colon.)

It's incredible that some terminals don't have a shift lock. To take care of this, ED-80 has a CASE command. Typing the word CASE when either in the command mode or the insert mode will alternately turn on the upper-case mode (equivalent to alternately pressing the usual shift-lock key). Fantastic, a software shift lock!

A command of DUMP, when in command mode, will print the current line, but with all of the control characters identified. Tabs will appear as ^I characters, and even the terminal carriage-return line-feed pair will appear at ^M^J. This makes it easy to distinguish tabs from blanks, and will show up any garbage that might be present.

The SCALE command, given while in command mode, prints the current line with a scale line of 0123456789012 etc., underneath. And below the unit-scale line is another line giving the tens locations. This command is useful for counting the number of blanks and things.

ENDING THE EDIT SESSION

The editing session is normally terminated with the command of EXIT. The editor responds with the name of the file that was edited (including the drive the new version will be saved on). This response is useful when several files have been created, and the current name is forgotten (especially with double-density diskettes).

If the editing session is to be discarded (because, for example, a D 128 command was given when only line 128 was to be deleted), a command of OMIT is given. If you've ever lost a long editing session because the power went out, you probably now make frequent backup copies during the session. This is easily done with ED-80 by using the RESTART command. It effectively performs an EXIT and then an EDIT command pair.

SUMMARY

This review was not intended to be an operator's manual, but rather just a discussion on some of the interesting features of ED-80. Yet there are so many interesting things, that the review just kept growing. ED-80 was used almost exclusively for the writing and editing of the work file for this present article. □

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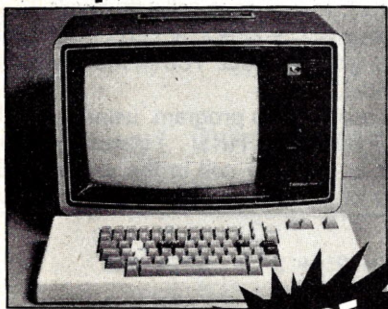

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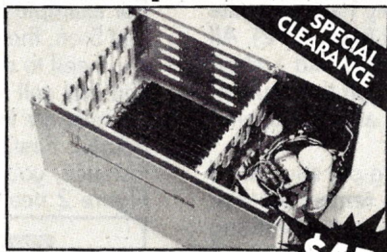

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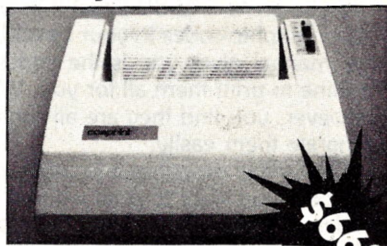

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Using TRS-80 Graphic Codes

By Woody Pope

If you are a TRS-80 Level II user, you may have seen the list of graphic codes in your Level II manual (page C/2). All the manual gives you is the codes (129-191) and a short routine to print them all for you. When you run this routine, however, you find they are all run together and you cannot separate them easily.

This article describes a formula for figuring out any one of the cells you want to print without trying to remember their codes or picking them out of the routine. A complete listing of all the cells is printed here.

0	1
2	3
4	5

Formula to turn on any or all six pixels:

$$N = 2^0 + 2^1 + 2^2 + 2^3 + 2^4 + 4^5 + 128$$

Figure 1. Basic Graphic Cell

Referring to Figure 1, notice that the cell is made up of six pixels numbered as shown 0-5. These numbers represent the powers of the base 2 that each pixel has as its address. For example (see Figure 2), to turn on a cell with pixels 1, 2 and 5 on, the graphics code is $2^1+2^2+2^5+128$ or 166. All you need to do is call the graphics code 166 in the program and, that cell will be printed.

There are two ways to use this in a program using Level II BASIC. First, using the PRINT @ CHR$( ) statement. For instance, you may want to print the cell in the example of Figure 2 near the center of the screen. Get out your Video Display Worksheet, found in either Level I or Level II manual, and locate an address near the center, say 542. Now simply make the statement say something like:

0	1
2	3
4	5

$$N = 2^1 + 2^2 + 2^5 + 128$$

$$N = 2 + 4 + 32 + 128$$

$$N = 166 \text{ (graphics code)}$$

Figure 2. Turning on pixels 1, 2, 5.

```
10 PRINT @ 542, CHR$(166)
```

and zappo. . .the cell is printed.

Second, you can use POKE statements. Referring again to the Video Worksheet, renumber all the addresses normally used when using PRINT @ (0-1023) with new addresses starting at 15360 and ending at 16383. These numbers are actual memory locations in RAM and correspond to 0-1023 addresses on the Video Worksheet. Now write:

```
10 POKE 15902, 166
```

and set the same thing as before. The address 15902 is obtained by adding 542 to 15360.

Figure 3 is the complete list of all 64 graphic cell types in a usable complementary pair table form. Using this table, let's make a robot's head on the screen.

```
 10 CLS
 20 FOR X = 286 TO 295
 30 PRINT @ X, CHR$ (191): NEXT X
 40 FOR X = 349 TO 360
 50 PRINT @X, CHR$ (191): NEXT X
 60 FOR X = 414 TO 423
 70 PRINT @ X, CHR$ (191): NEXT X
 80 PRINT @ 352, CHR$ (176):
 90 PRINT @ 353, CHR$ (176):
100 PRINT @ 356, CHR$ (176):
110 PRINT @ 357, CHR$ (176):
120 FOR X = 417 TO 420
130 PRINT @ X, CHR$ (179): NEXT X
140 GO TO 140
```

Lines 20 through 70 white in the head's outline. Lines 80 through 110 draw the two eyes, and lines 120 through 130 draw the mouth. Line 140 allows the program to loop so no "READY" will be printed on your picture. To break out of the loop, hit "BREAK" key. The trailing semicolons in lines 80 through 110 keep the printing of the eyes from wiping out the bottom of the jaw.

With a bit of imagination and the foregoing methods, you can do some very good graphics on your TRS-80.□

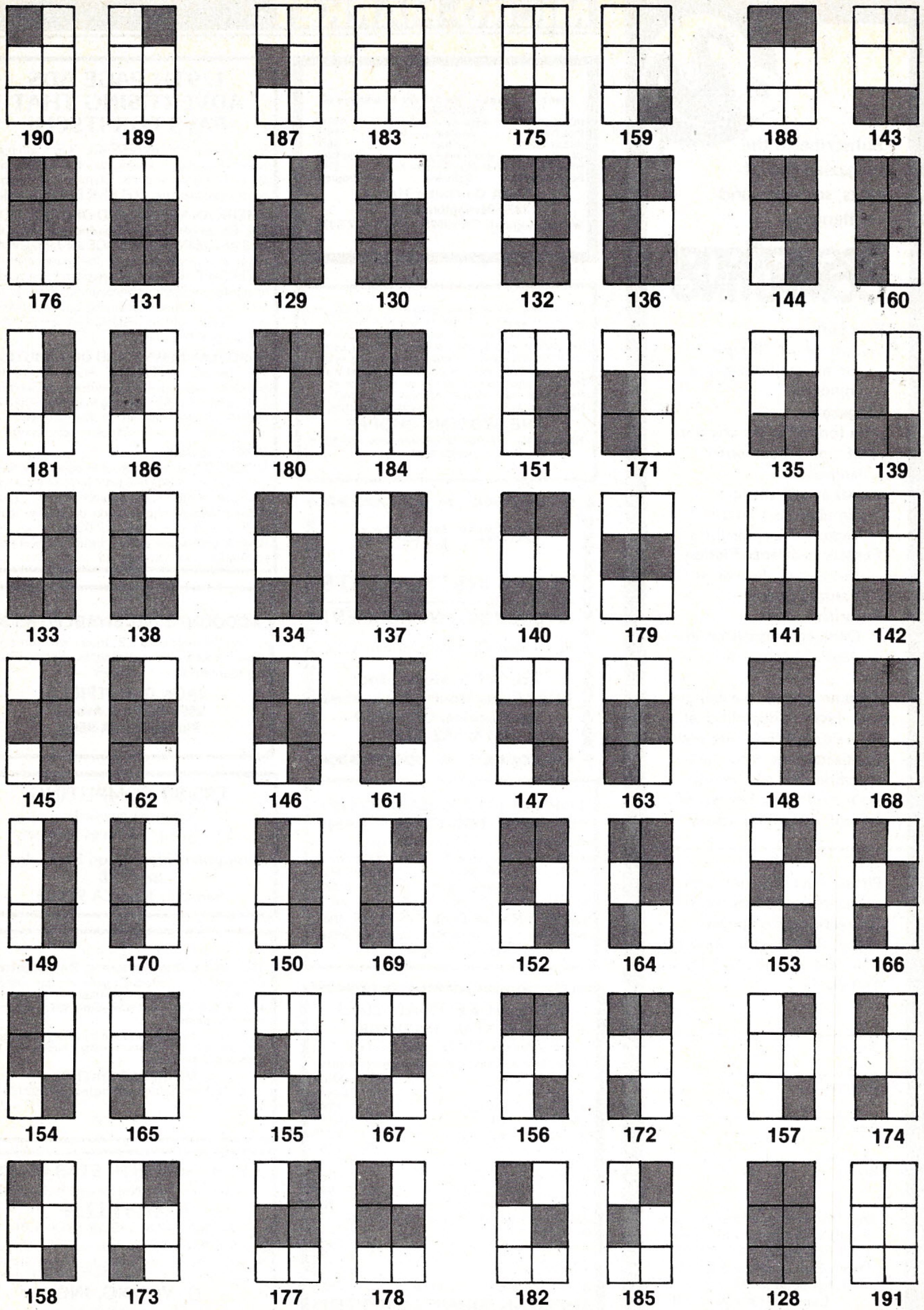
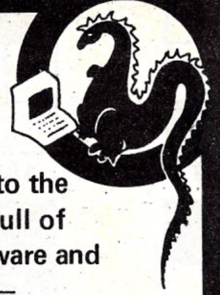


Figure 3. Graphic Cells Grouped in Complementary Pairs



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